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(12) **United States Patent**  
**Richman et al.**

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(45) **Date of Patent: Oct. 7, 2003**

(54) **INFORMATION SYSTEM AND METHOD USING ANALYSIS BASED ON OBJECT-CENTRIC LONGITUDINAL DATA**

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(73) Assignee: **Algoplus Consulting Limited**, Halifax (CA)

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(51) **Int. Cl.**<sup>7</sup> ..... **G06F 17/30**  
(52) **U.S. Cl.** ..... **707/104.1**  
(58) **Field of Search** ..... 707/1, 10, 104.1, 707/102, 500, 513; 303/126; 342/29; 600/300; 701/29, 120, 123; 705/2, 3

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*Primary Examiner*—Diane D. Mizrahi

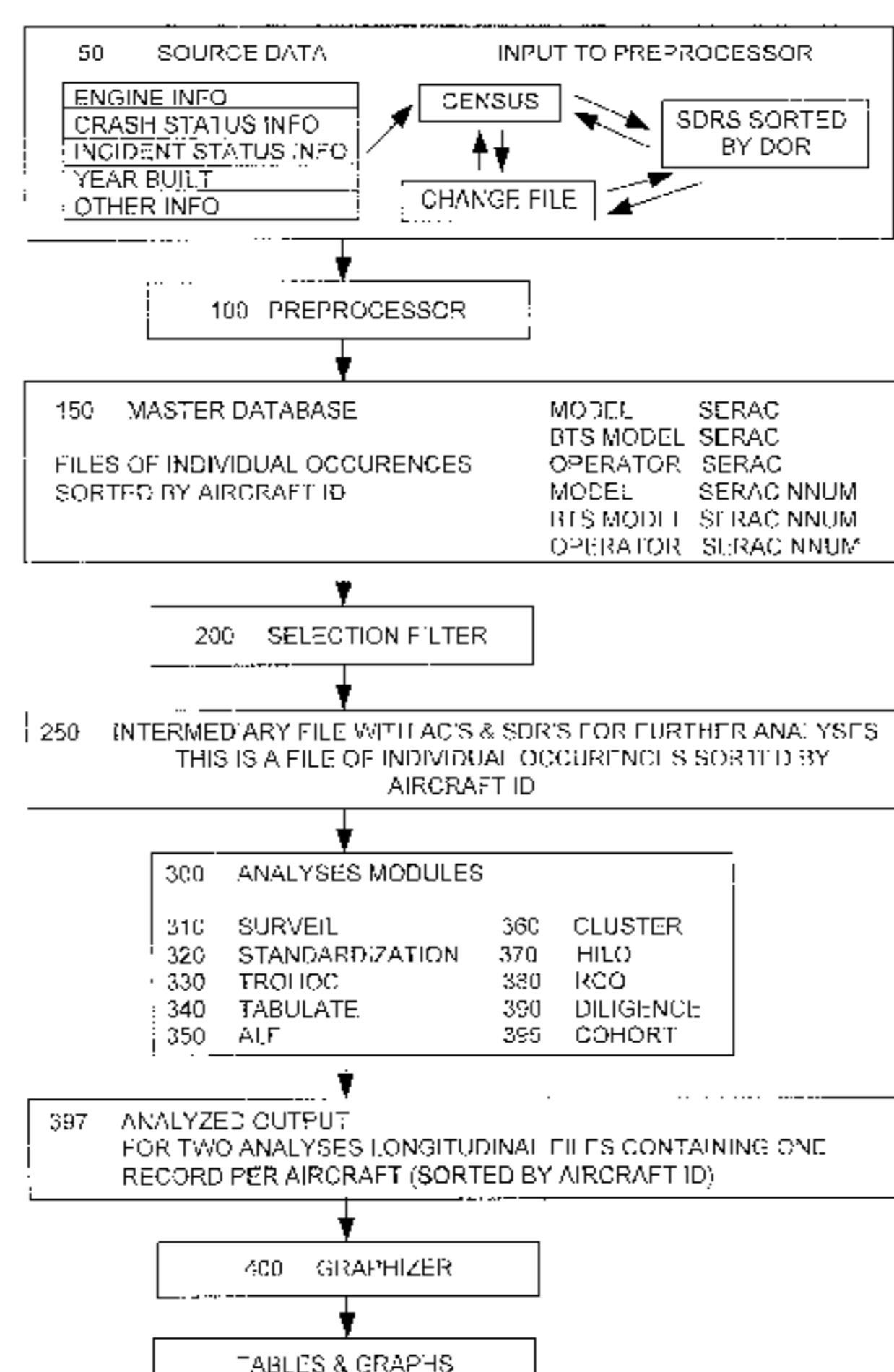
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(57) **ABSTRACT**

A computerized information system and method using object-centric virtual database(s) and analyses advantageously suited to transportation safety applications, such as for the aviation industry (in which case aircraft may be the unit of observation i.e. the object class, and the individual object is an individual aircraft), as well as for health and other safety monitoring applications. A database comprises at least one set of data records, each data record pertaining to an event for an individual object and comprising a plurality of data fields, at least one of the data fields comprising an identifier identifying one individual object. A user interface component receives user-selected criteria for field values of the data fields and a selection component selects those data records which correspond to the user-selected criteria. An analysis component identifies the selected data records according to a chronological sequence of events for individual objects covered by the selected data records, whereby each individual object covered by the selected data records is associated with a longitudinal set of data records, and derives output data for the events from the longitudinal sets of data records.

**15 Claims, 31 Drawing Sheets**



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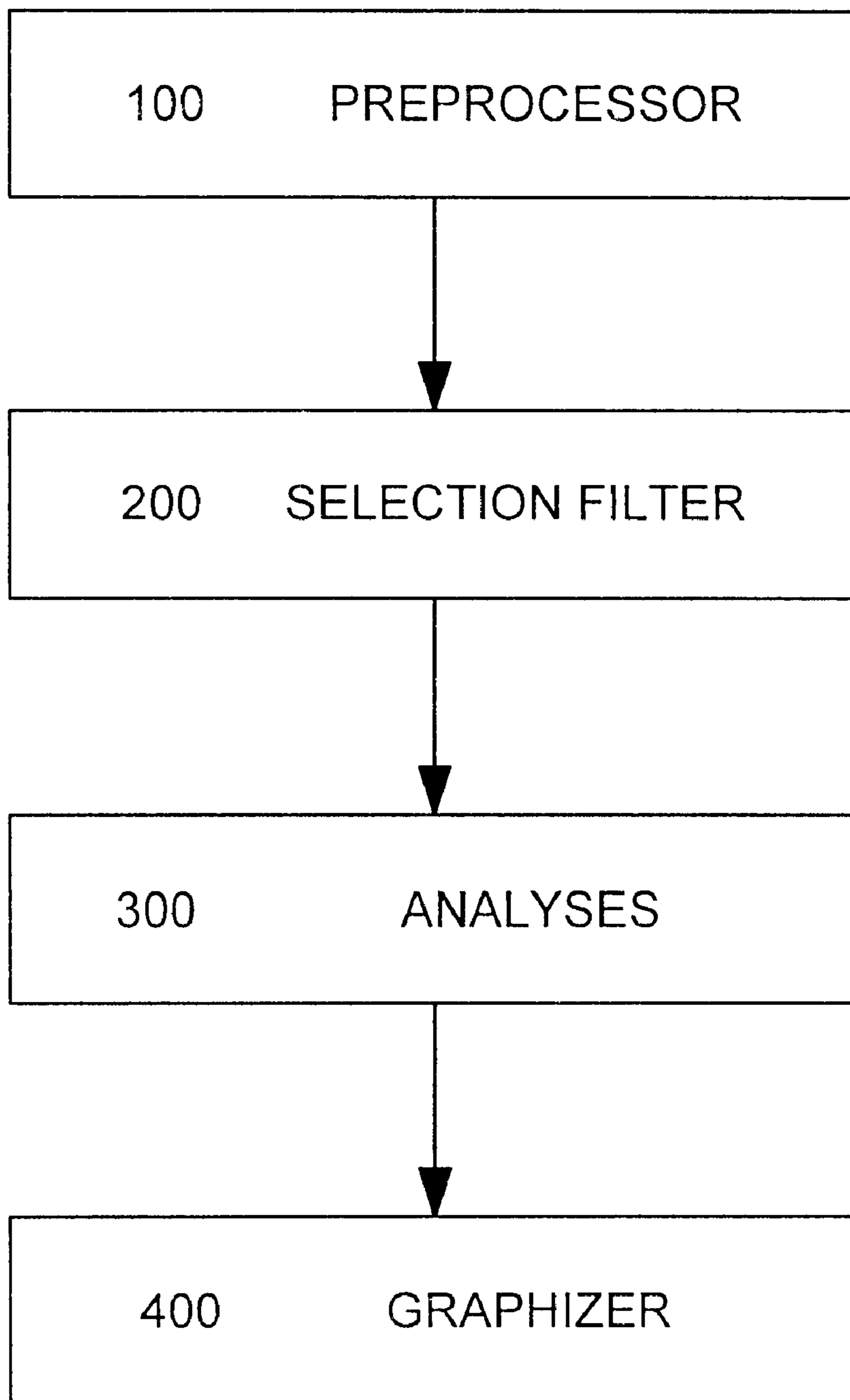
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**FIG. 1**

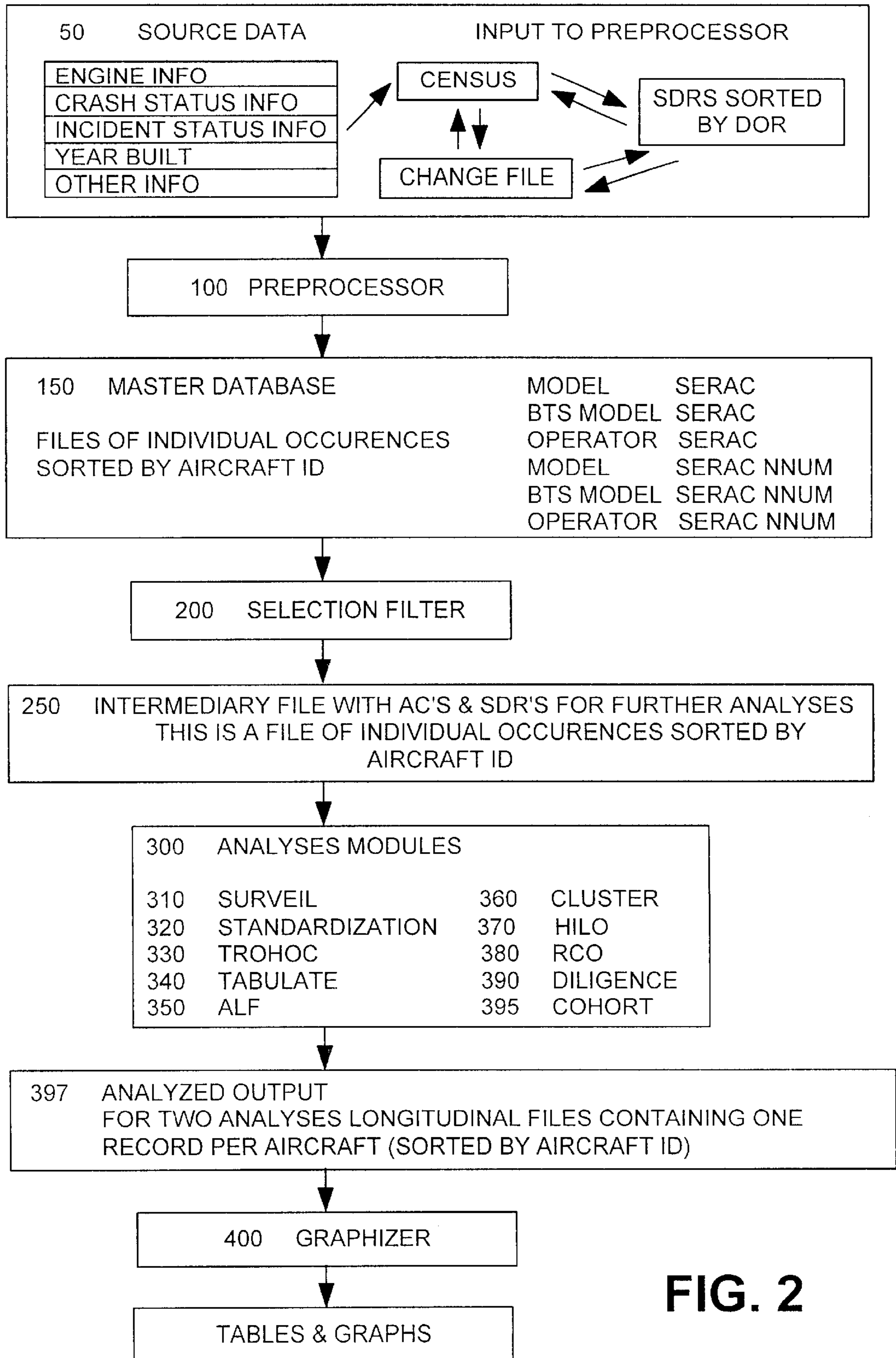
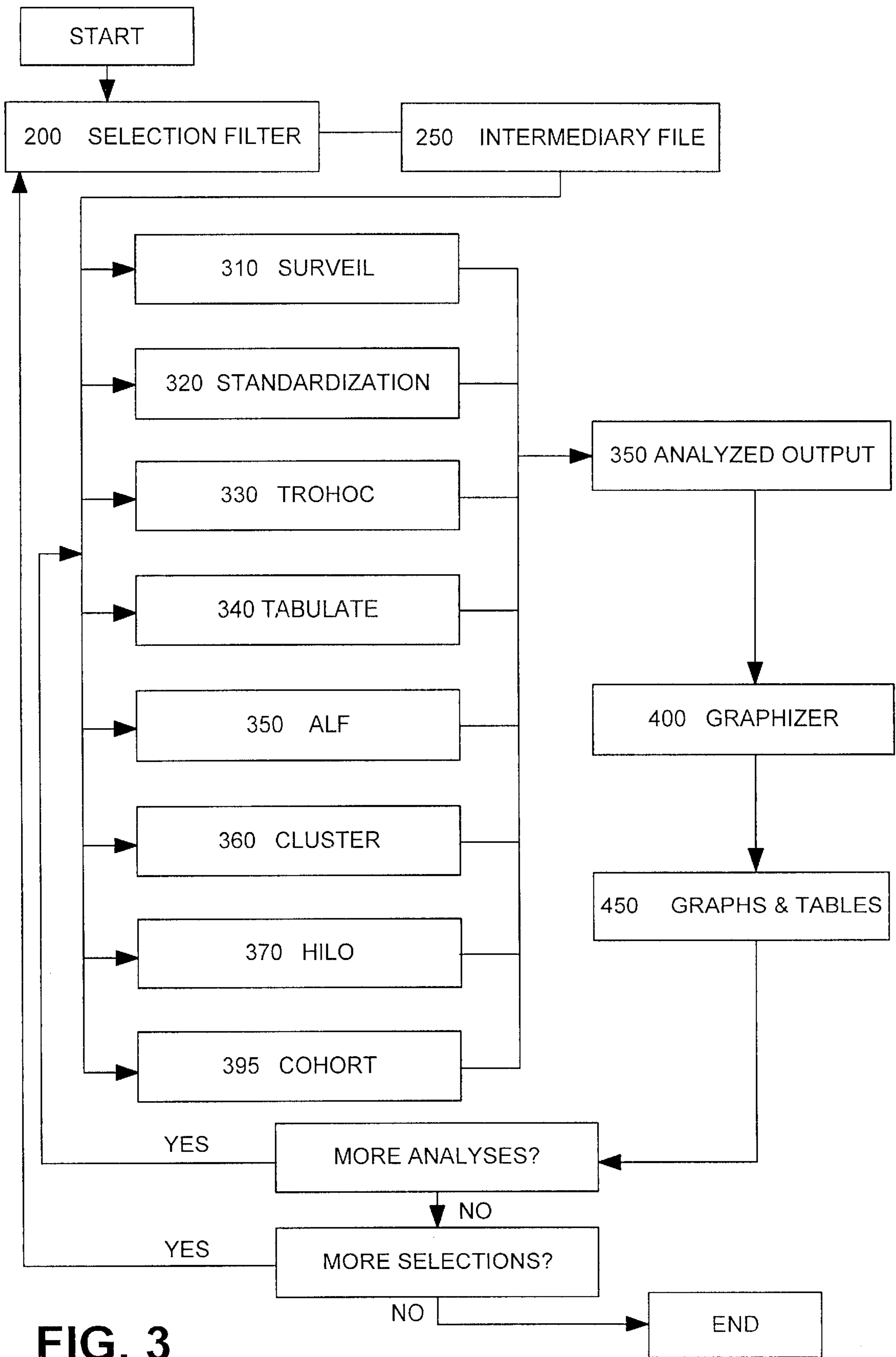


FIG. 2



**FIG. 3**

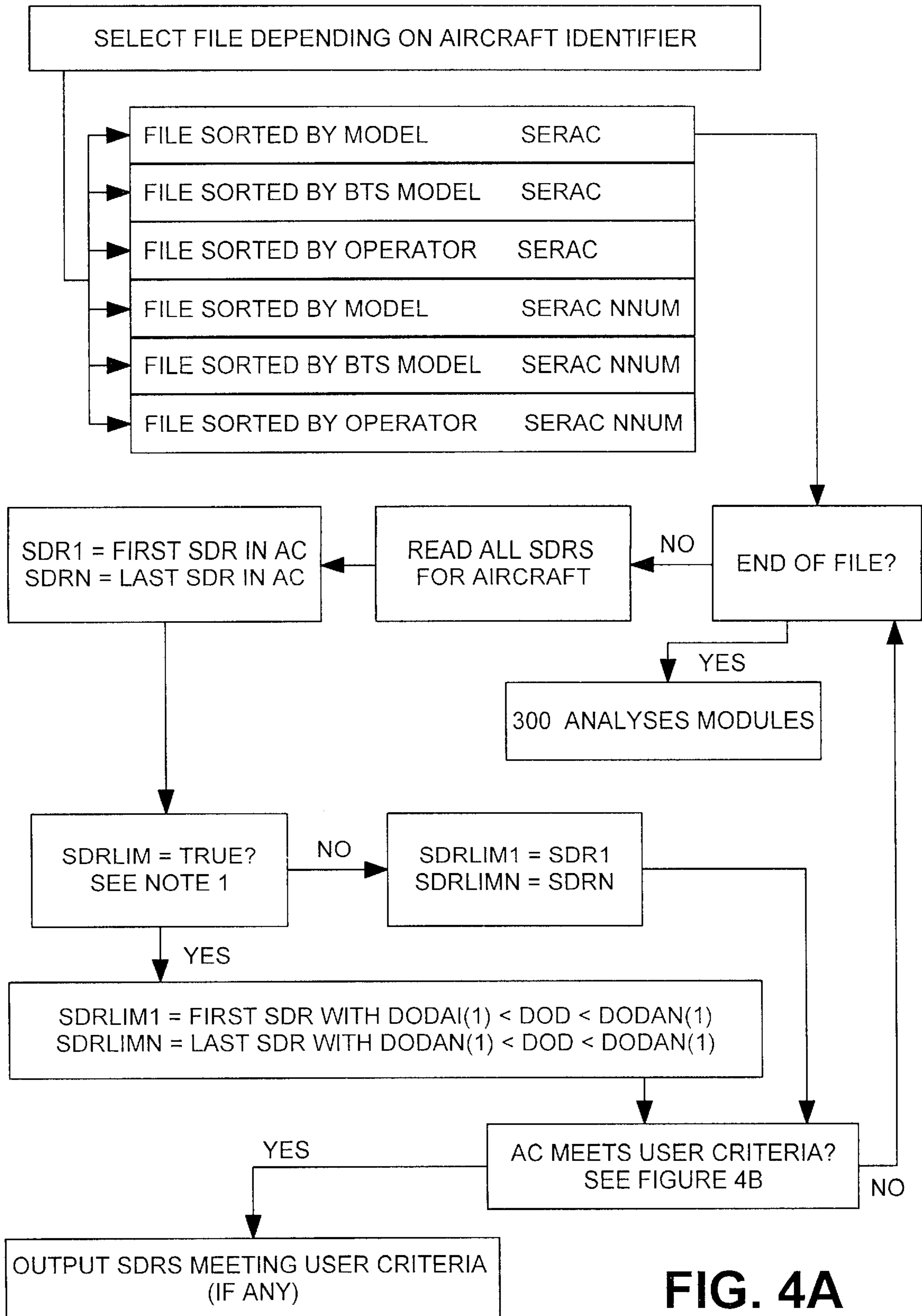


FIG. 4A

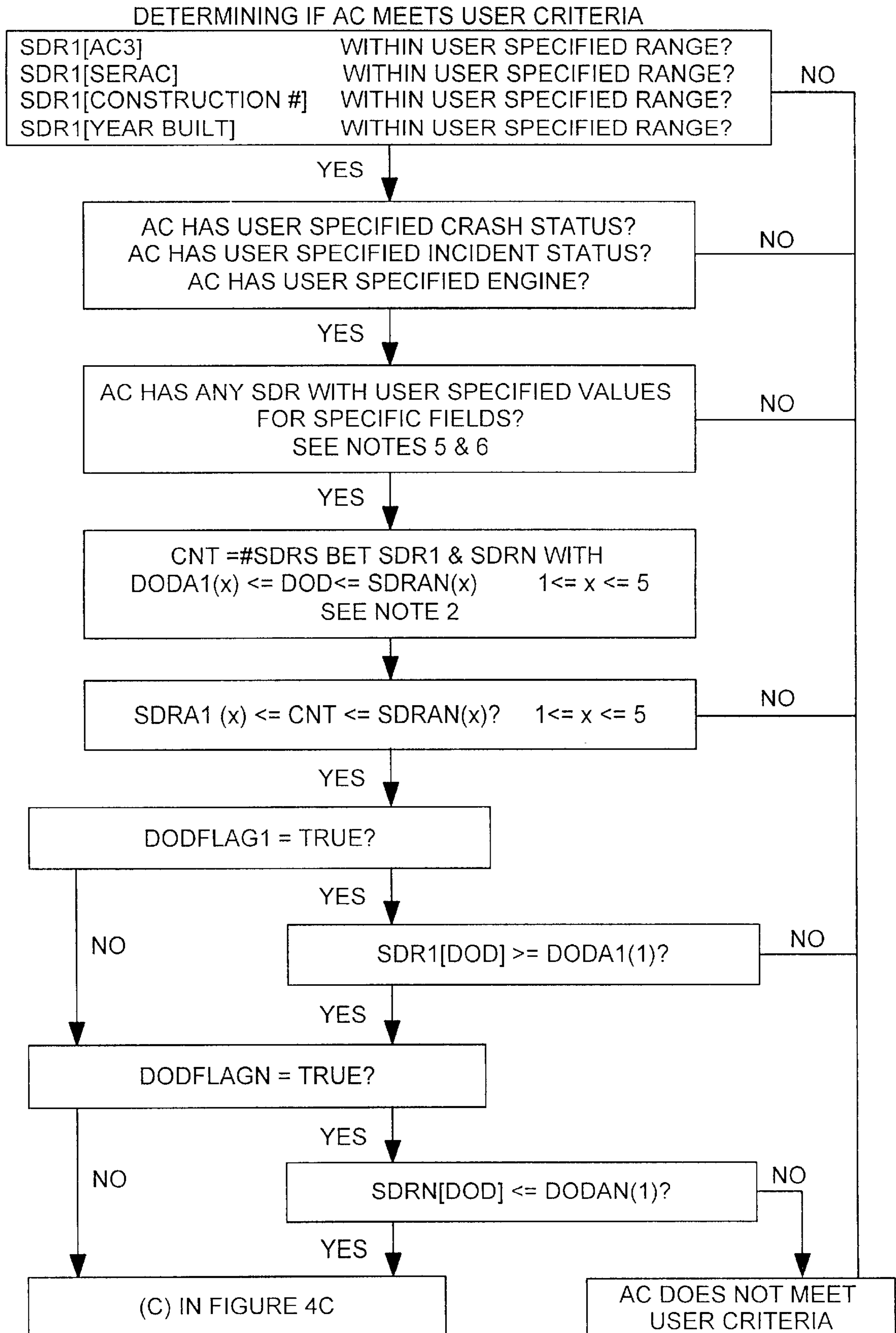


FIG. 4B

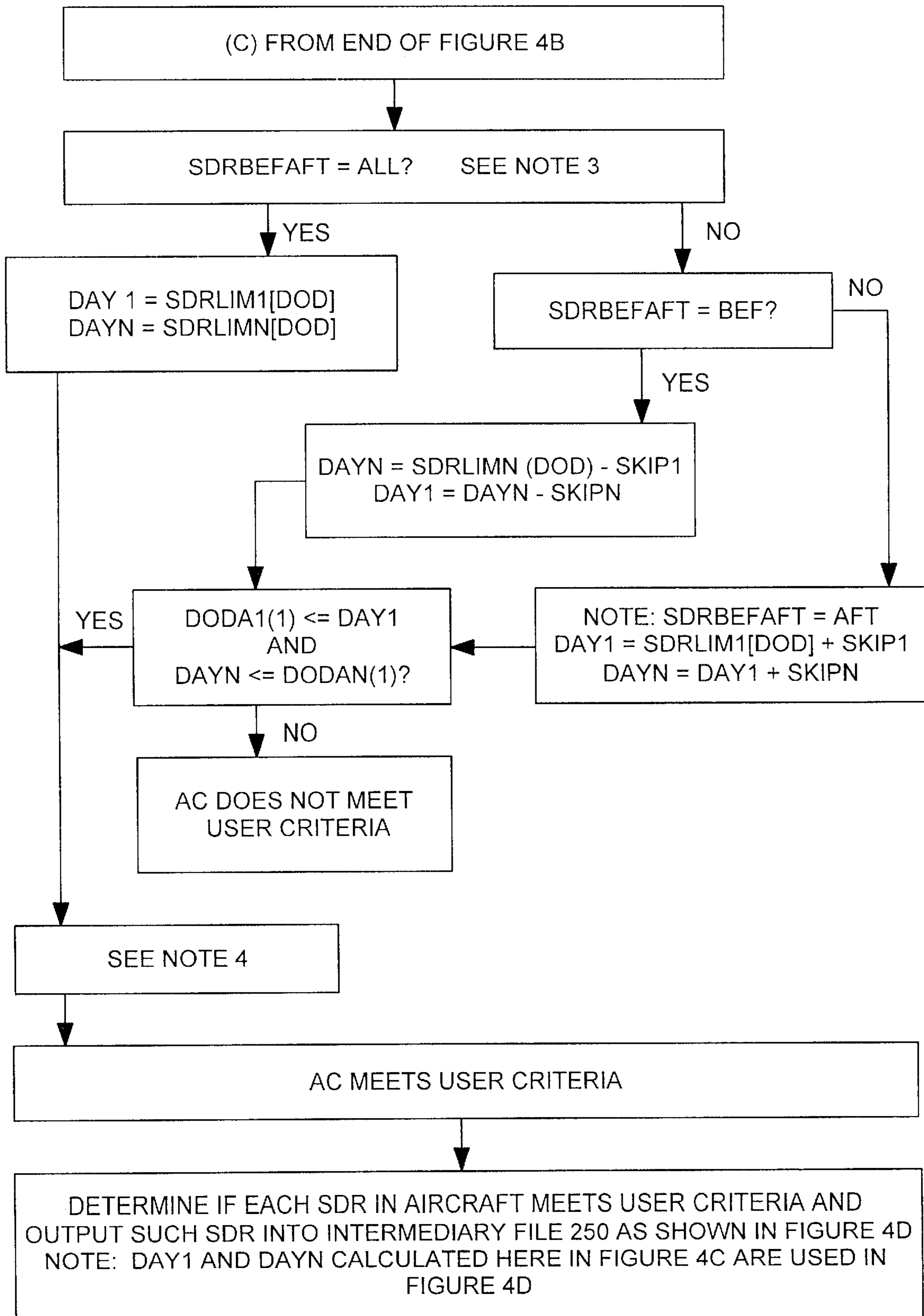


FIG. 4C



DETERMINING IF AN SDR MEETS USER CRITERIA

NOTE: AFTER AN AIRCRAFT IS DEEMED TO HAVE MET THE USER CRITERIA AS PER FIGURES 4A AND 4B, SDRS MEETING USER CRITERIA ARE OUTPUT TO AN INTERMEDIARY FILE (250) FOR FURTHER ANALYSES (300)

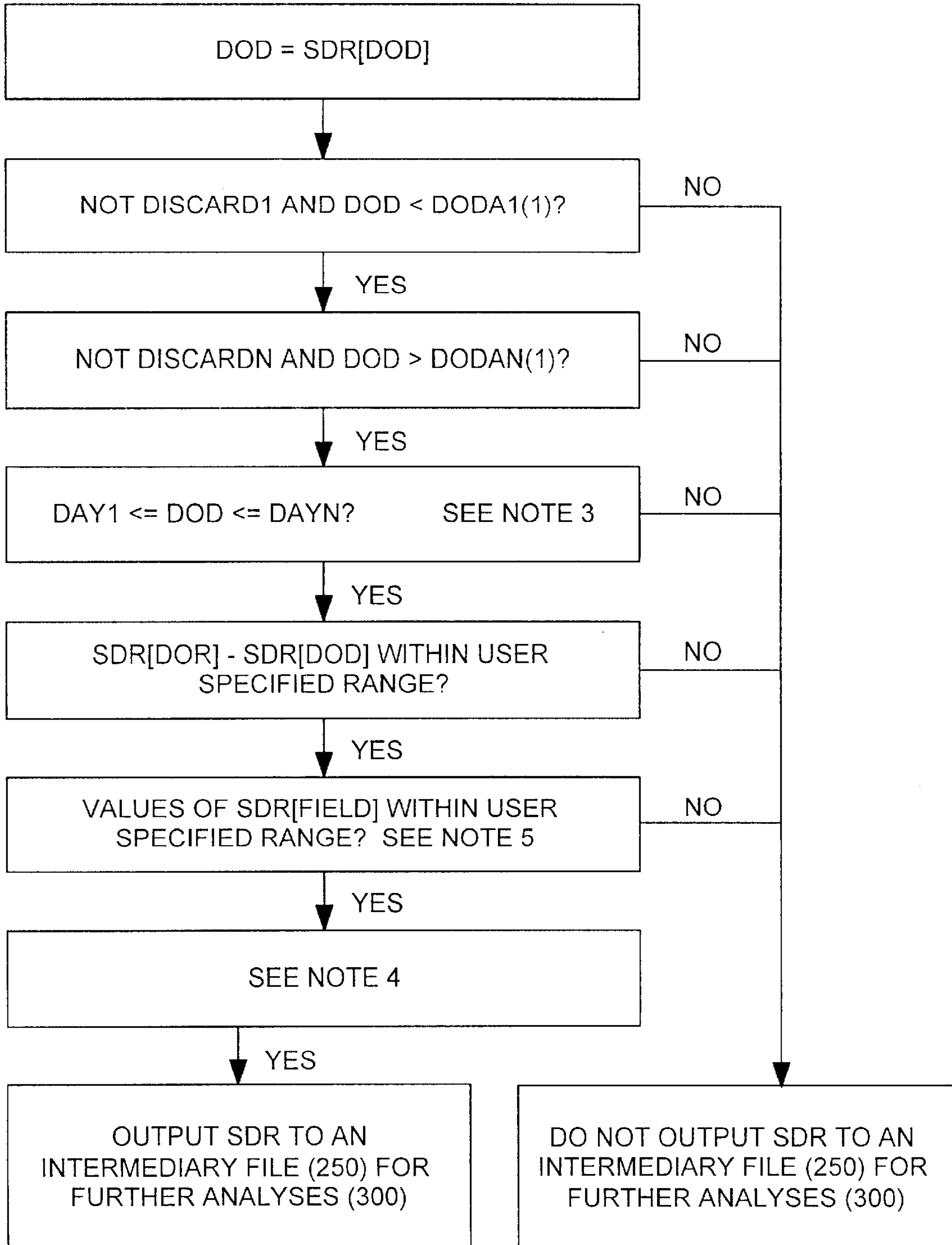


FIG. 4D



CALCULATING REPEATS FOR AN AIRCRAFT

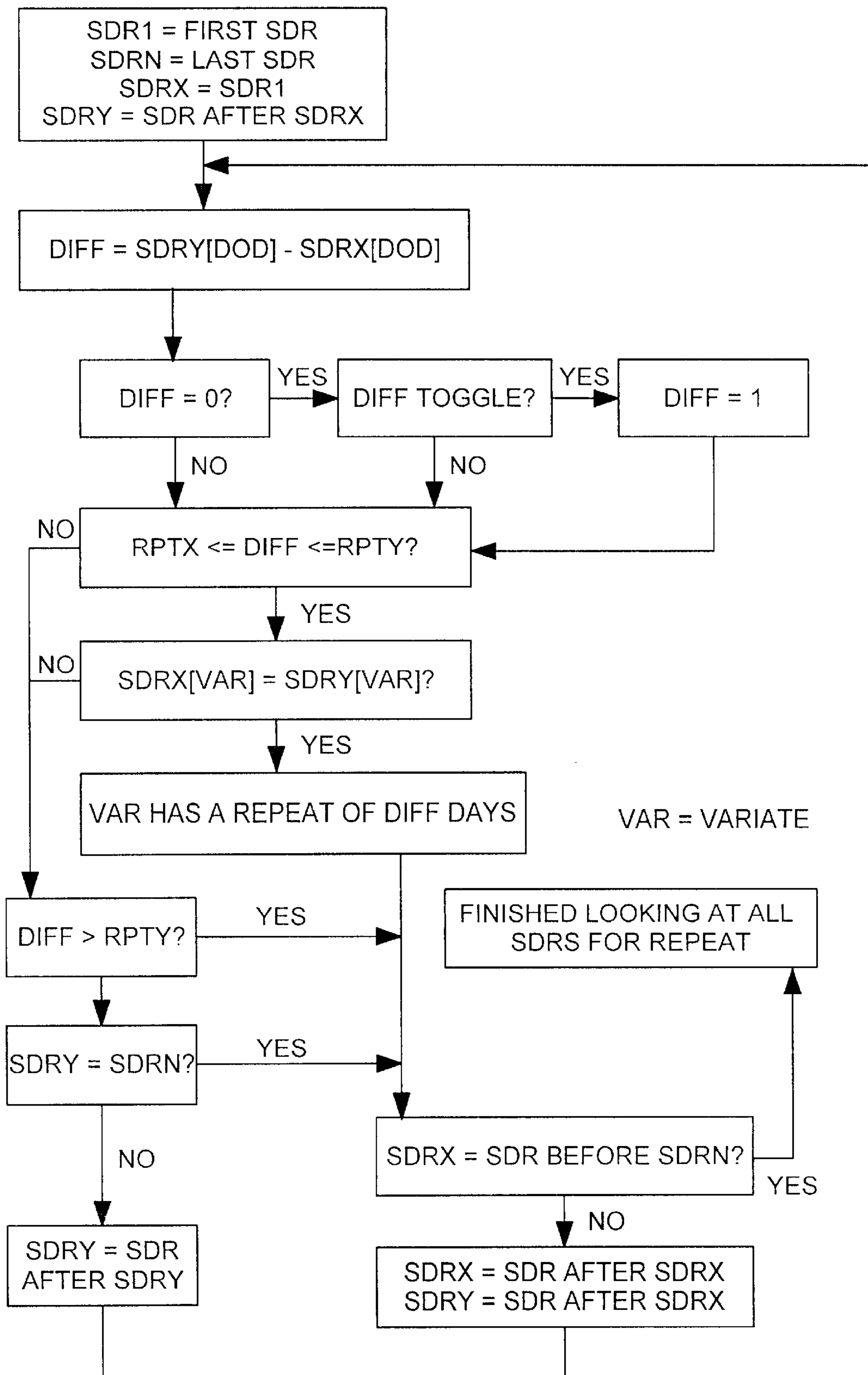
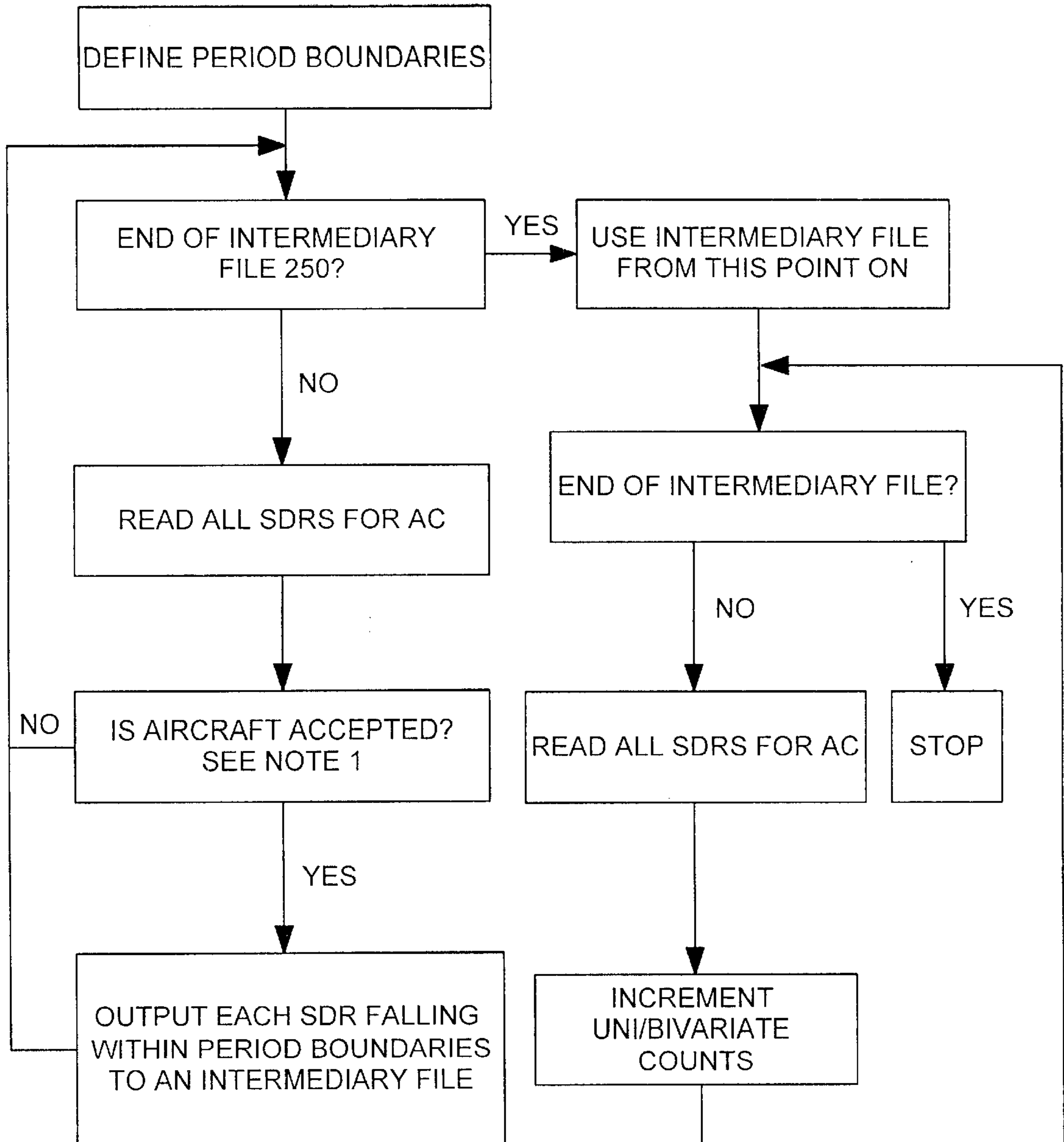


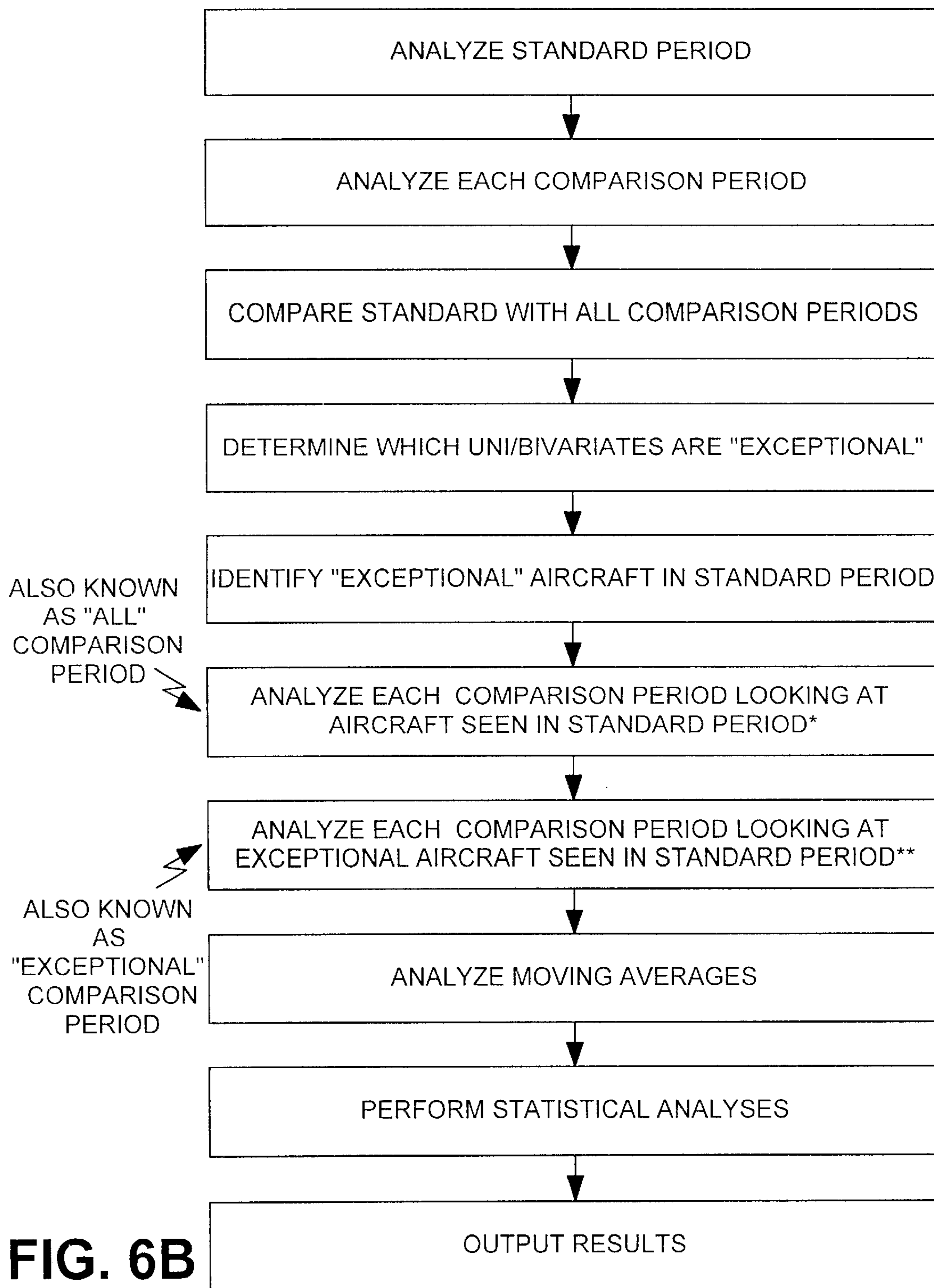
FIG. 5



NOTE 1

- ALL AIRCRAFT IN THE STANDARD PERIOD ARE ACCEPTED.
- ALL AIRCRAFT IN COMPARISON PERIOD ARE ACCEPTED.
- AN AIRCRAFT IN AN "ALL" COMPARISON PERIOD IS ACCEPTED IF IT IS ALSO SEEN IN THE STANDARD PERIOD
- AN AIRCRAFT IN AN 'EXCEPTIONAL' COMPARISON PERIOD IS ACCEPTED IF IT IS IS AN EXCEPTIONAL AIRCRAFT SEEN IN THE STANDARD PERIOD
- ALL AC'S IN MOVING AVERAGE ARE ACCEPTED

**FIG. 6A**



\*IF AN AIRCRAFT IN THE EXTRA COMPARISON PERIOD IS NOT ALSO AN AIRCRAFT SEEN IN THE STANDARD PERIOD, IT IS NOT ANALYZED.

\*\*IF AN AIRCRAFT IN THE EXTRA COMPARISON PERIOD IS NOT ALSO AN EXCEPTIONAL AIRCRAFT SEEN IN THE STANDARD PERIOD, IT IS NOT ANALYZED.

FORMING MOVING AVERAGES FROM COMPARISON PERIODS

CP1	CP2	CP3	CP4	CP5	CP6	CP7
-----	-----	-----	-----	-----	-----	-----

MA1 = CP1, 2, 3

MA2 = CP2, 3, 4

MA3 = CP3, 4, 5

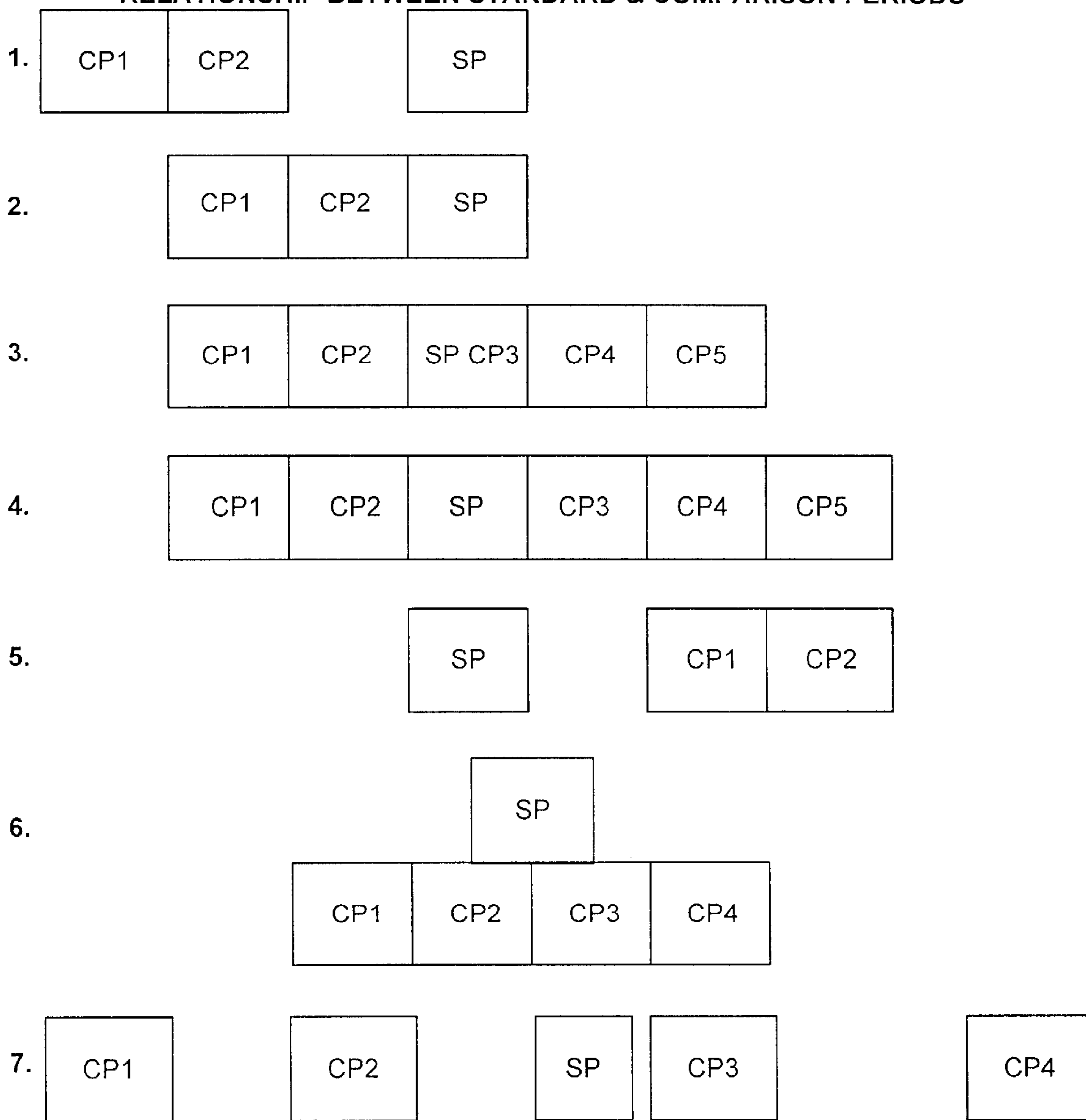
MA4 = CP4, 5, 6

MA5 = CP5, 6, 7

CP = COMPARISON PERIOD  
MA = MOVING AVERAGE

**FIG. 6C**

RELATIONSHIP BETWEEN STANDARD & COMPARISON PERIODS



SP = STANDARD PERIOD  
 CP = COMPARISON PERIOD

1. CP BEFORE SP, NONE ADJACENT TO SP
2. CP BEFORE SP, ONE ADJACENT TO SP
3. CP BEFORE & AFTER SP, SP DOUBLES UP AS CP
4. CP BEFORE & AFTER SP, SP DOES NOT DOUBLE UP AS CP
5. CP AFTER SP, NONE ADJACENT TO SP
6. CP BEFORE & AFTER SP, NONE ADJACENT TO SP
7. CP BEFORE & AFTER SP, CP'S WIDELY DISPERSED

**FIG. 6D**

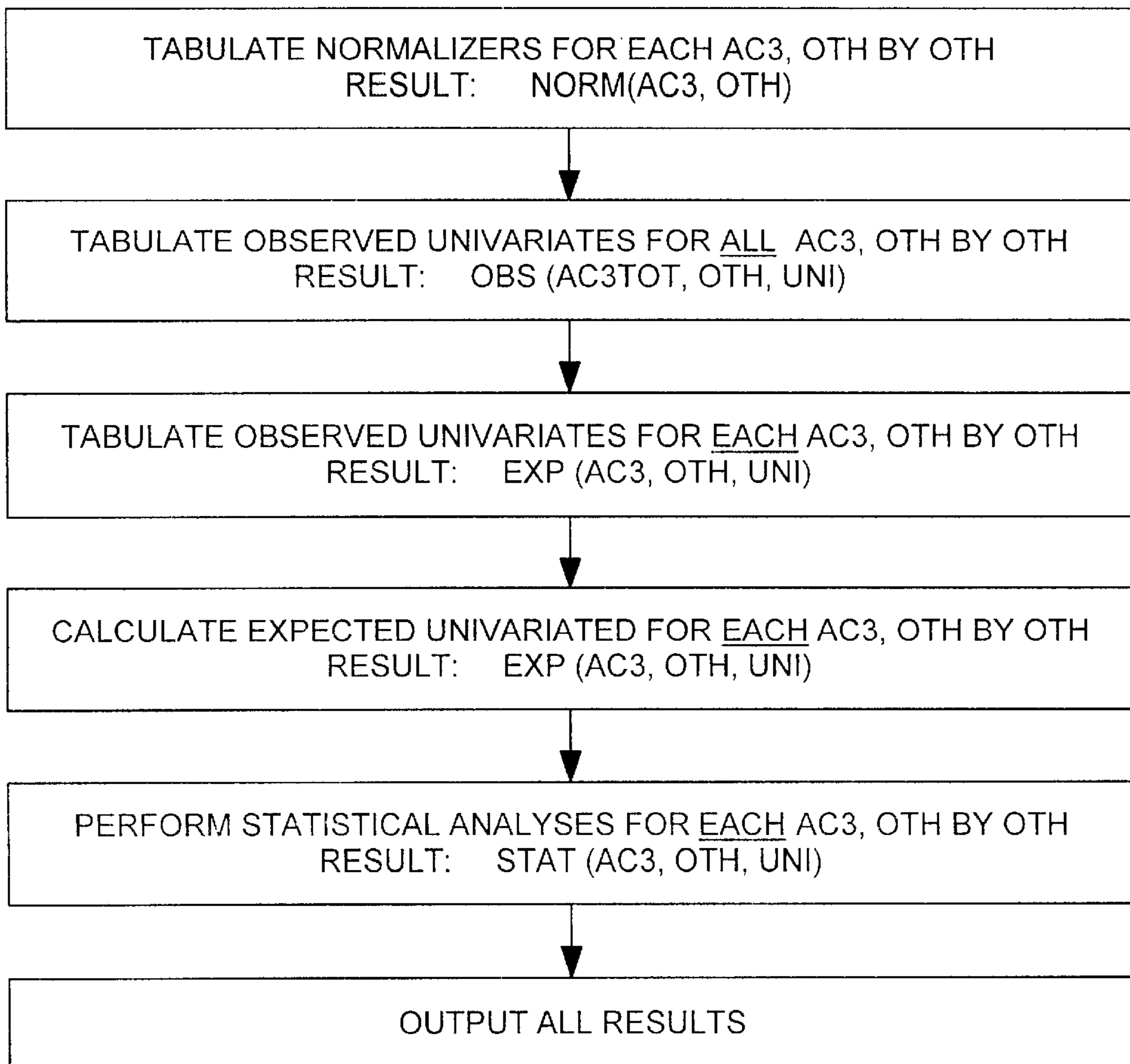


FIG. 7A

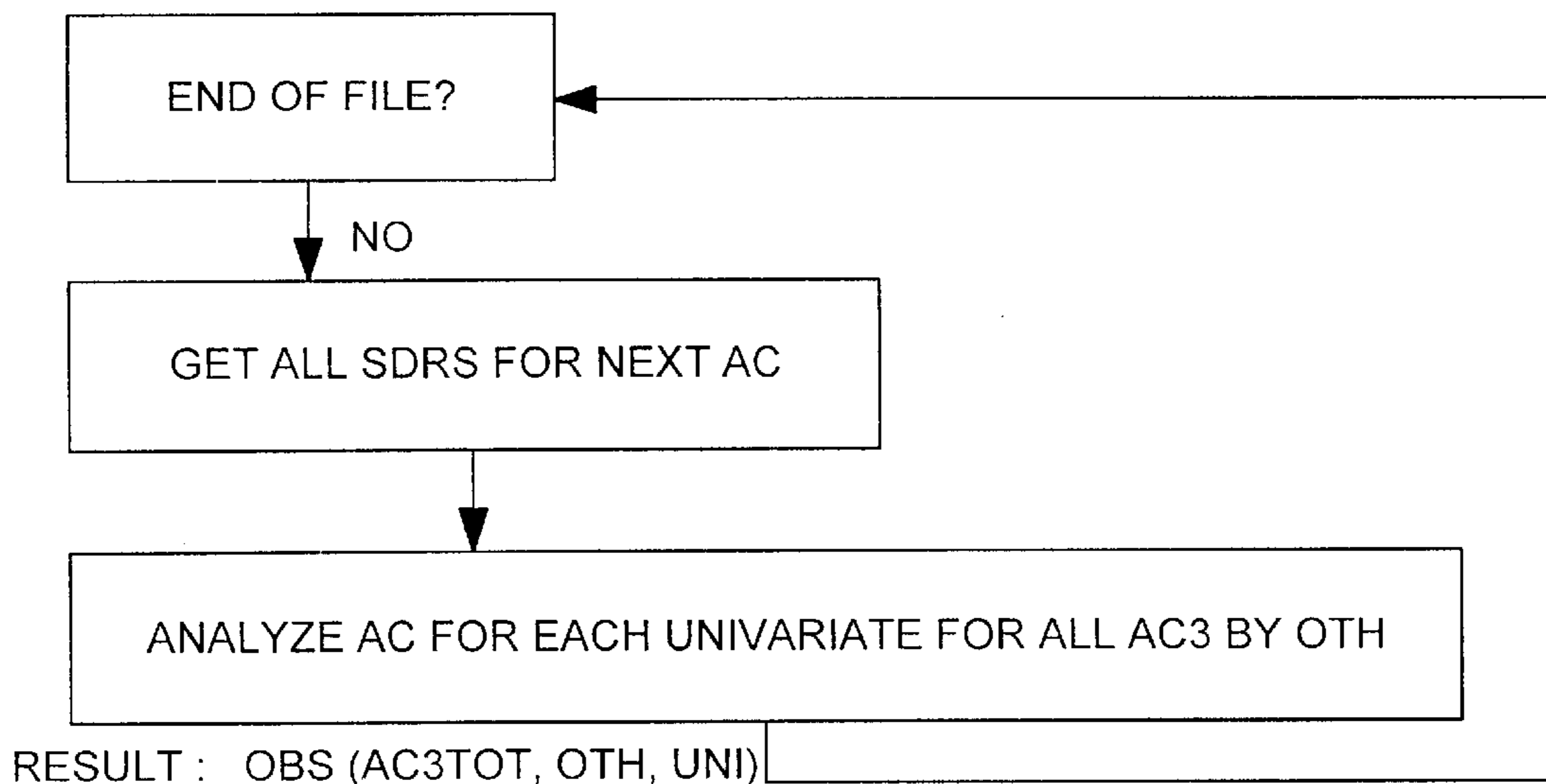
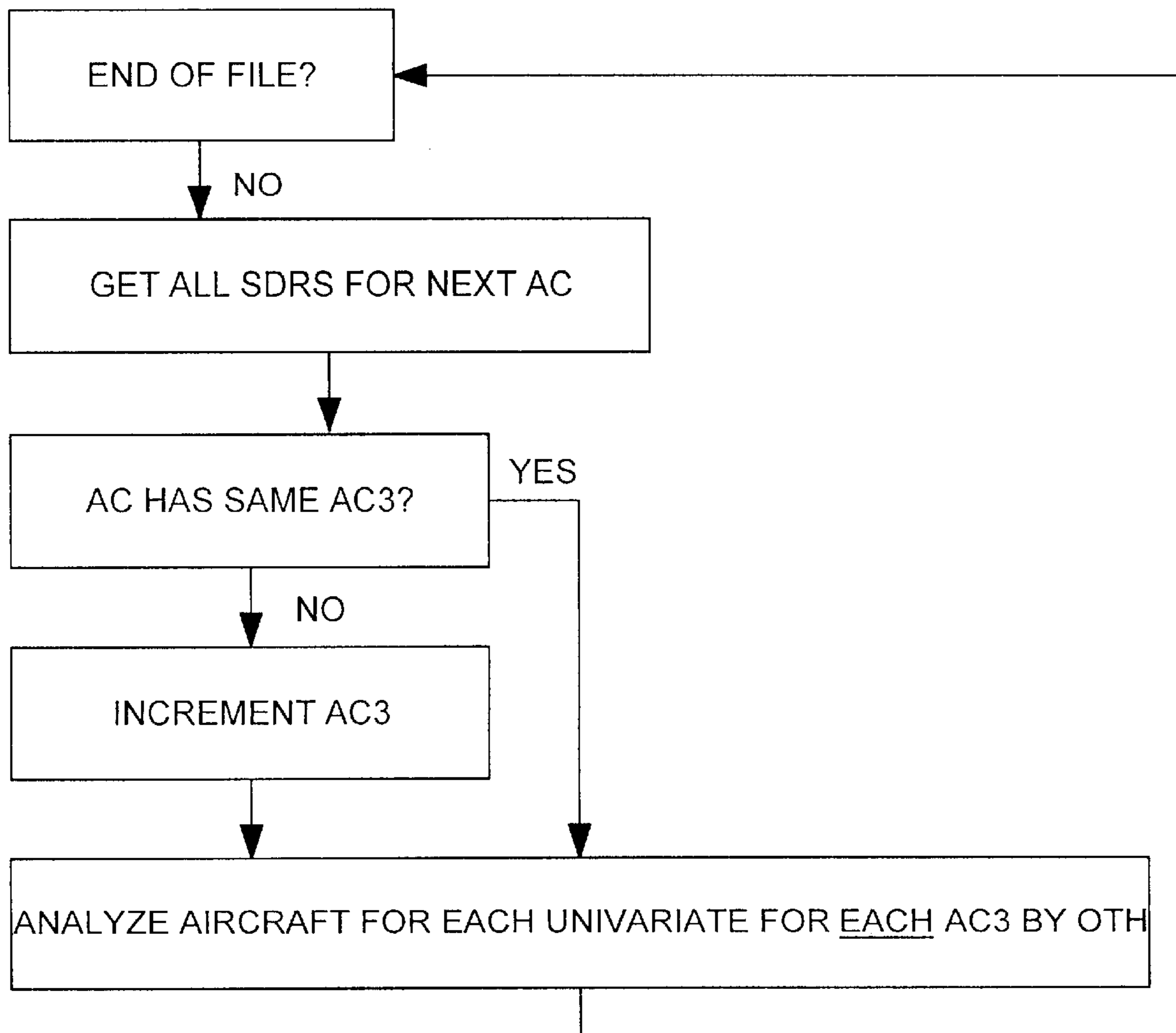


FIG. 7B





RESULT: OBS (AC3, OTH, UNI)

**FIG. 7C**

FOR AC3 = AC31 TO AC3N

FOR OTH = OTH1 TO OTHN

FOR UNI = UNI1 TO UNIN

$$\text{RATIO} = \frac{\text{NORM}(\text{AC3}, \text{OTH})}{\text{NORM}(\text{AC3ALL}, \text{OTH})}$$

$$\text{EXP}(\text{AC3}, \text{OTH}, \text{UNI}) = \text{RATIO} \times \text{OBS}(\text{AC3ALL}, \text{OTH}, \text{UNI})$$

NEXT UNI

NEXT OTH

NEXT AC3

---

FOR AC3 = AC31 TO AC3N

FOR OTH = OTH1 TO OTHN

FOR UNI = UNI1 TO UNIN

$$\text{PRIORITY}(\text{AC3}, \text{OTH}, \text{UNI}) = \frac{\text{OBS}(\text{AC3}, \text{OTH}, \text{UNI}) \times 100}{\text{EXP}(\text{ACE}, \text{OTH}, \text{UNI})}$$

NEXT UNI

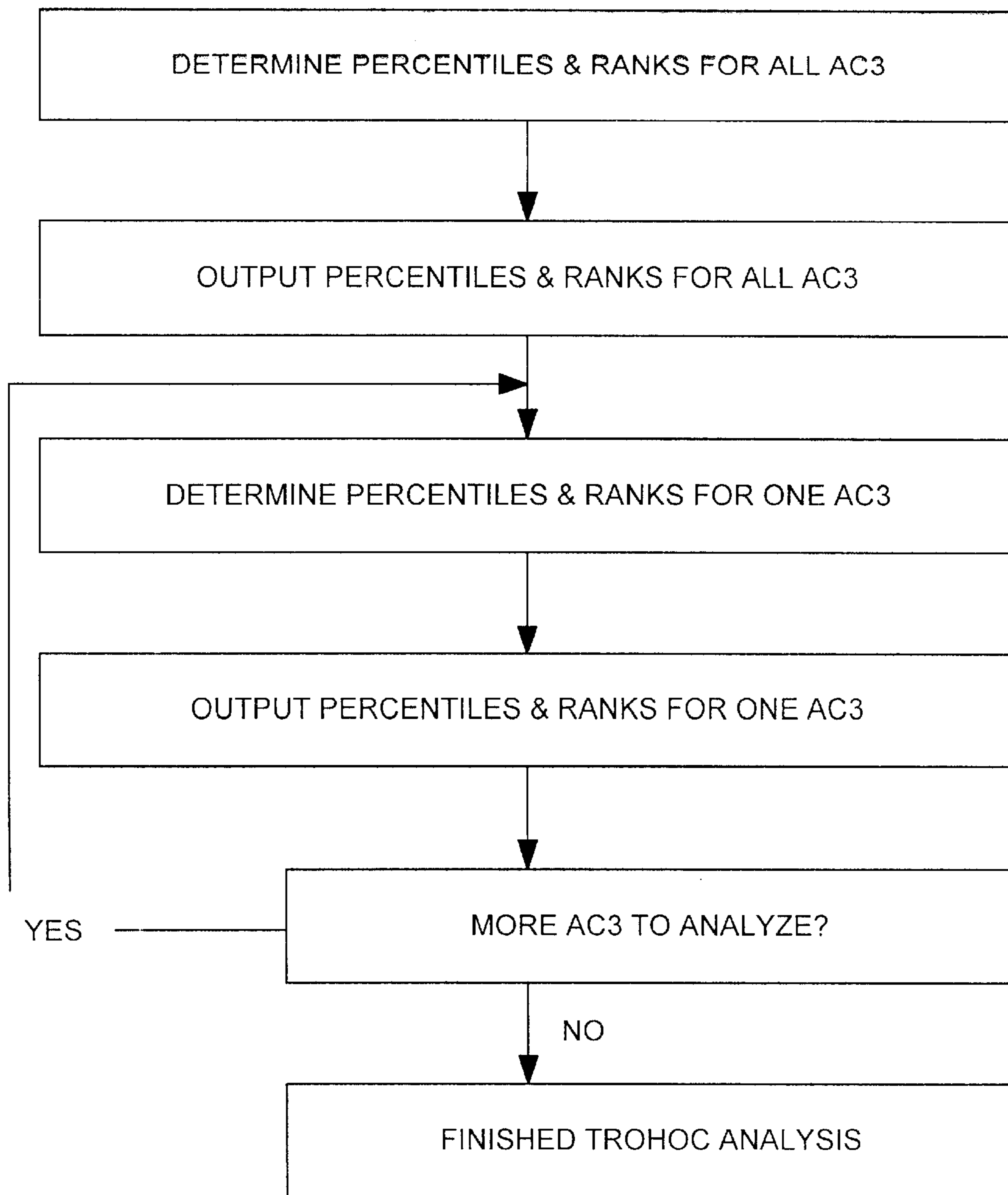
NEXT OTH

NEXT AC3



EG: OTHER STATISTICAL ANALYSES PERFORMED HERE  
LOWER/HIGHER CONFIDENCE  
LOWER/HIGHER CONFIDENCE LIMITS

**FIG. 7D**



**FIG. 8A**

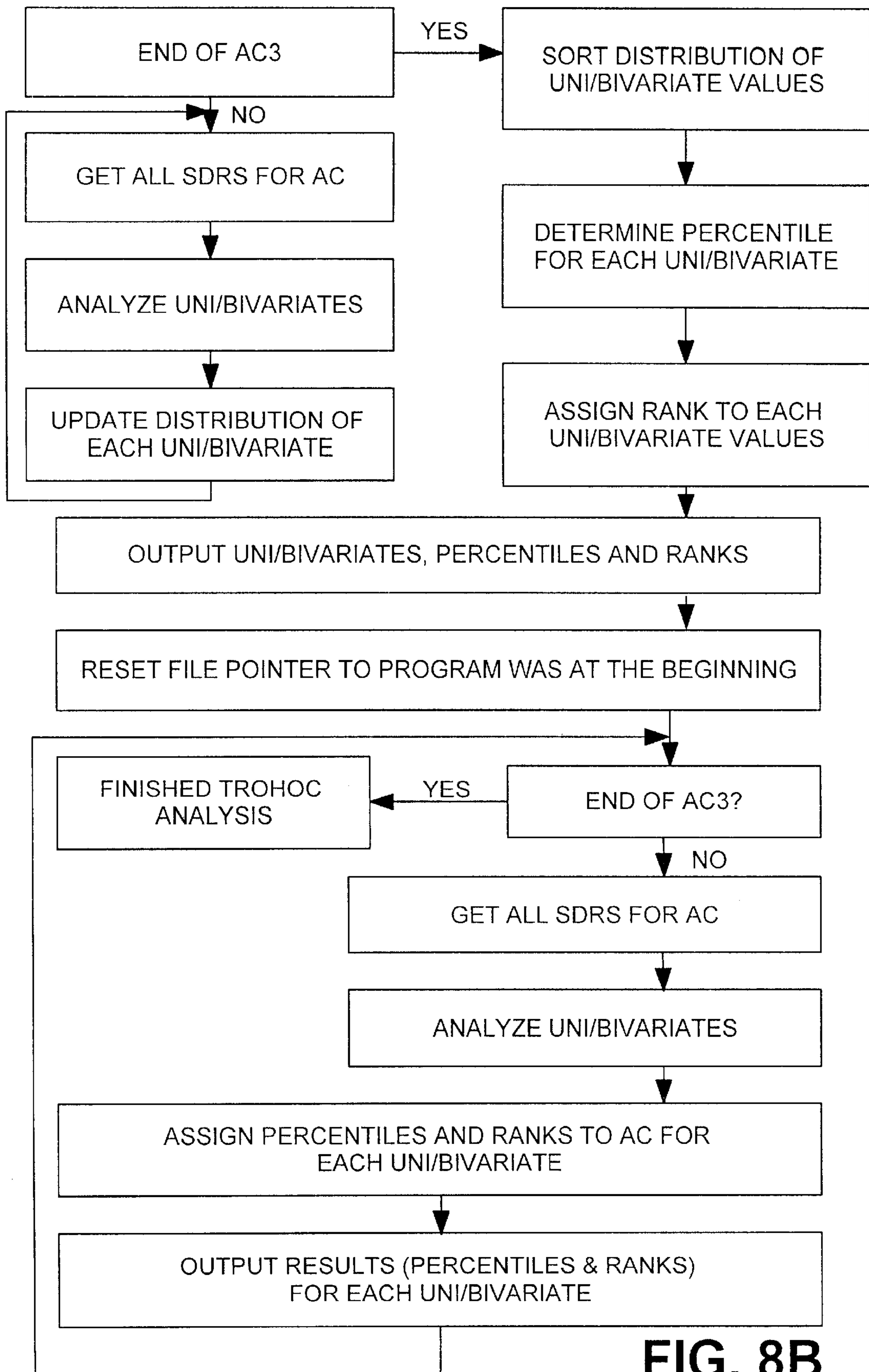


FIG. 8B

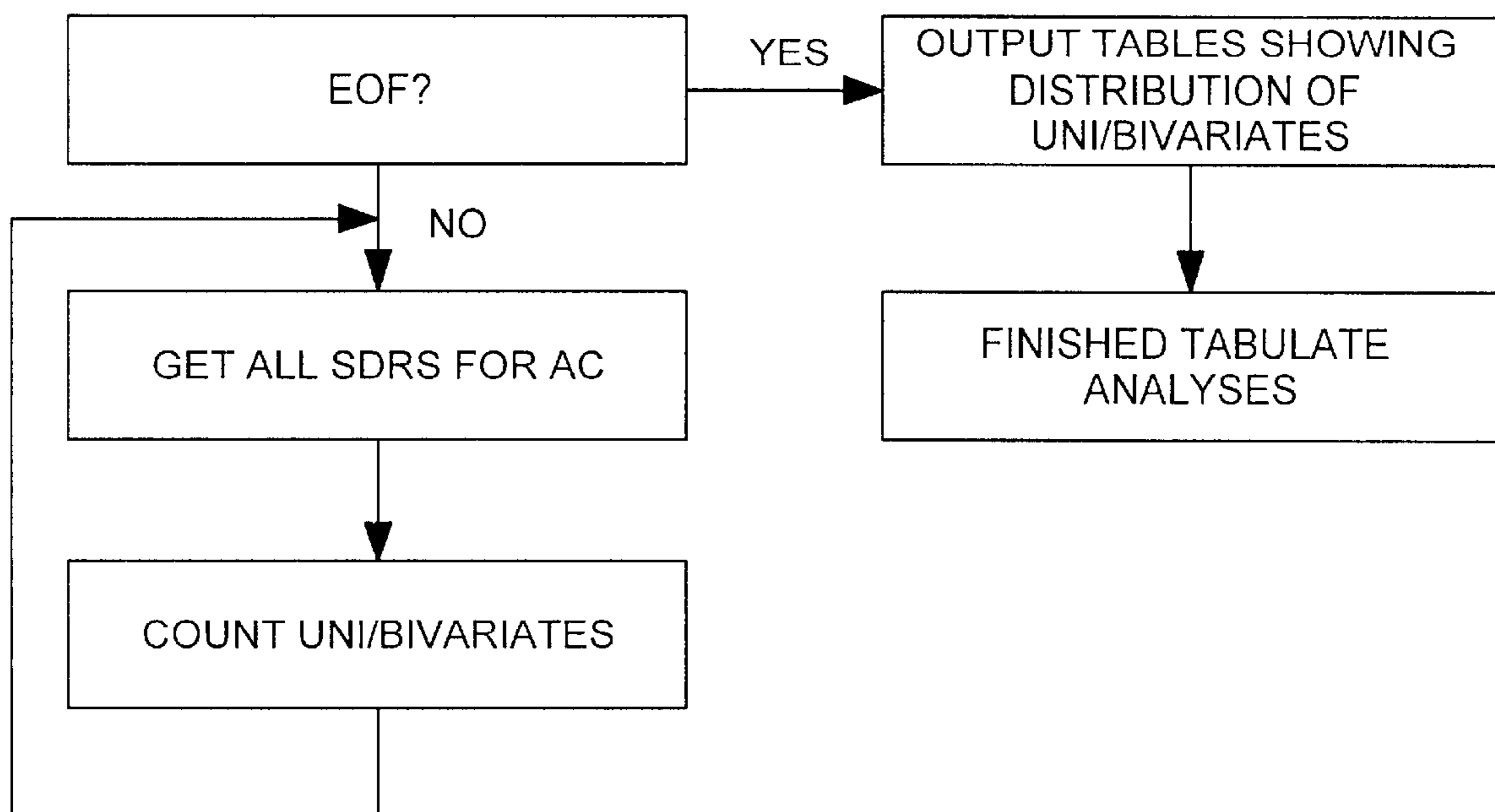


FIG. 9

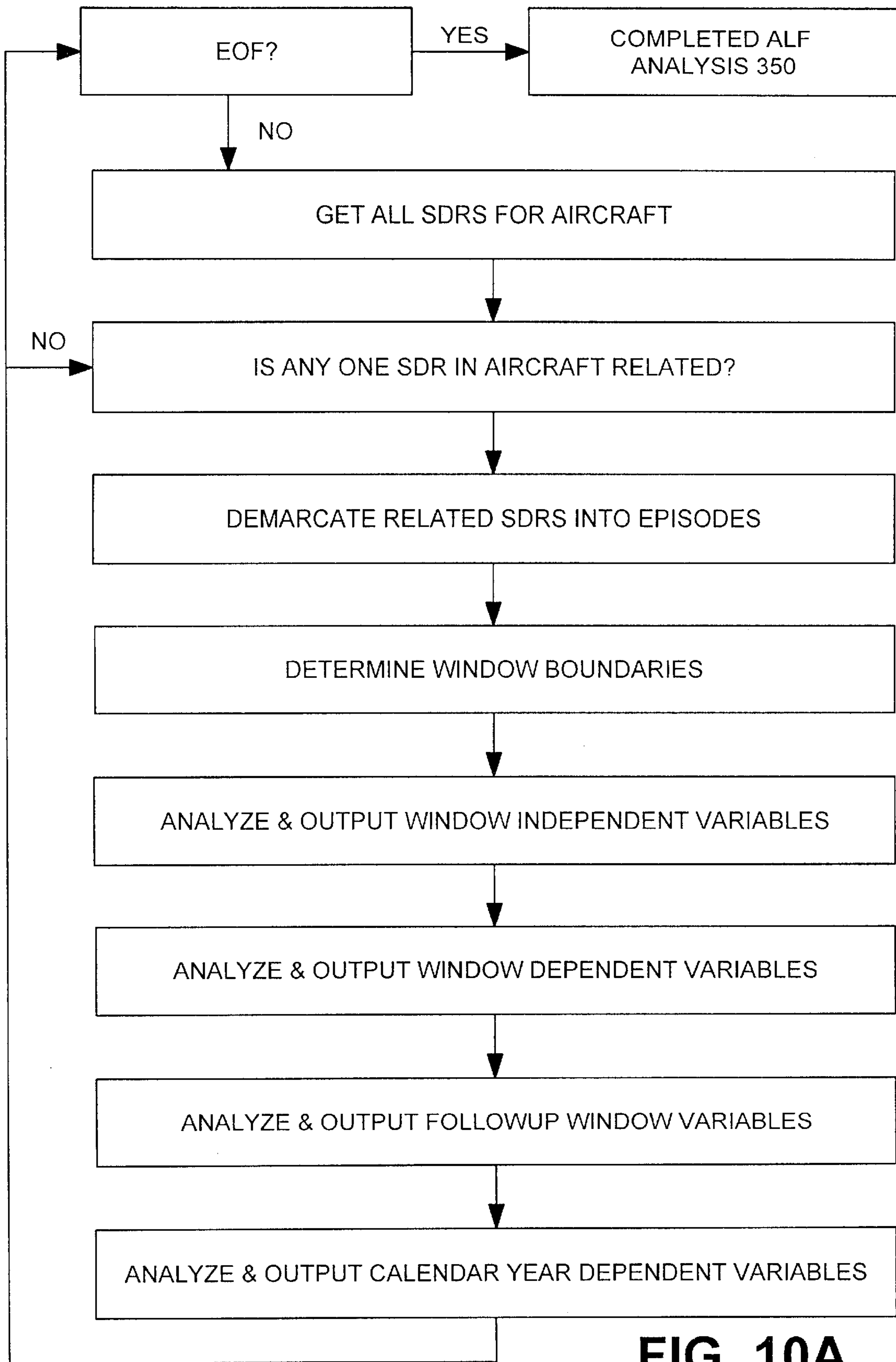


FIG. 10A

NUMBER OF SDRS IN AIRCRAFT  
NUMBER OF SDRS WITHIN USER-SPECIFIED DAYS BEFORE OR AFTER EACH UEL  
NATURE OF CONDITION (NC) "COMBO CODE" FOR ALL SDRS IN AIRCRAFT  
PRECAUTIONARY PROCEDURE (PP) COMBO CODE FOR ALL SDRS IN AIRCRAFT  
NUMBER OF UELS (TYPE = 1) IN A GIVEN MONTH OF ANY YEAR  
NUMBER OF UELS (TYPE = 1) IN AIRCRAFT  
SHORTEST INTERVAL BETWEEN ANY TWO UELS (TYPE = 1) IN AIRCRAFT  
NUMBER OF MAJORS (TYPE = 2) IN AIRCRAFT  
SHORTEST INTERVAL BETWEEN ANY TWO MAJORS (TYPE = 2) IN AIRCRAFT  
NUMBER OF ROUTINES (TYPE = 3) IN AIRCRAFT  
SHORTEST INTERVAL BETWEEN ANY TWO ROUTINES (TYPE = 3) IN AIRCRAFT  
NUMBER OF NMNRS (TYPE = 4) IN AIRCRAFT  
SHORTEST INTERVAL BETWEEN ANY TWO NMNRS (TYPE = 4) IN AIRCRAFT  
NUMBER OF SDRS IN AIRCRAFT FOR USER-SPECIFIED YEAR  
NUMBER OF UELS (TYPE = 1) IN AIRCRAFT FOR USER SPECIFIED CALENDAR YEAR  
NUMBER OF MAJORS (TYPE = 2) IN AIRCRAFT FOR USER SPECIFIED CALENDAR YEAR  
NUMBER OF ROUTINES (TYPE = 3) IN AIRCRAFT FOR USER SPECIFIED CALENDAR YEAR  
NUMBER OF NMNRS (TYPE = 4) IN AIRCRAFT FOR USER SPECIFIED CALENDAR YEAR  
OPERATOR NUMBER OF FIRST SDR IN USER-SPECIFIED CALENDAR YEAR  
NATURE OF CONDITION OF FIRST SDR IN USER-SPECIFIED CALENDAR YEAR  
INTERVAL BETWEEN AIRCRAFT'S 1ST SDR AND ITS LAST SDR  
1ST SHORTEST INTERVAL (DAYS) BETWEEN TWO SDRS IN AIRCRAFT  
2ND SHORTEST INTERVAL (DAYS) BETWEEN TWO SDRS IN AIRCRAFT  
3RD SHORTEST INTERVAL (DAYS) BETWEEN TWO SDRS IN AIRCRAFT  
LONGEST INTERVAL (DAYS) BETWEEN TWO SDRS IN AIRCRAFT  
INTERVAL BETWEEN AIRCRAFT'S 1ST UEL AND ITS LAST UEL  
1ST SHORTEST INTERVAL (DAYS) BETWEEN TWO UELS IN AIRCRAFT  
2ND SHORTEST INTERVAL (DAYS) BETWEEN TWO UELS IN AIRCRAFT  
3RD SHORTEST INTERVAL (DAYS) BETWEEN TWO UELS IN AIRCRAFT  
LONGEST INTERVAL (DAYS) BETWEEN TWO UELS IN AIRCRAFT  
INTERVAL BETWEEN AIRCRAFT'S 1ST MAJOR AND ITS LAST MAJOR  
1ST SHORTEST INTERVAL (DAYS) BETWEEN TWO MAJORS IN AIRCRAFT  
2ND SHORTEST INTERVAL (DAYS) BETWEEN TWO MAJORS IN AIRCRAFT  
3RD SHORTEST INTERVAL (DAYS) BETWEEN TWO MAJORS IN AIRCRAFT  
LONGEST INTERVAL (DAYS) BETWEEN TWO MAJORS IN AIRCRAFT  
INTERVAL BETWEEN AIRCRAFT'S 1ST ROUTINE AND ITS LAST ROUTINE  
1ST SHORTEST INTERVAL (DAYS) BETWEEN TWO ROUTINES IN AIRCRAFT  
2ND SHORTEST INTERVAL (DAYS) BETWEEN TWO ROUTINES IN AIRCRAFT  
3RD SHORTEST INTERVAL (DAYS) BETWEEN TWO ROUTINES IN AIRCRAFT  
LONGEST INTERVAL (DAYS) BETWEEN TWO ROUTINES IN AIRCRAFT  
INTERVAL BETWEEN AIRCRAFT'S 1ST NMNR AND ITS LAST NMNR  
1ST SHORTEST INTERVAL (DAYS) BETWEEN TWO NMNRS IN AIRCRAFT  
2ND SHORTEST INTERVAL (DAYS) BETWEEN TWO NMNRS IN AIRCRAFT  
3RD SHORTEST INTERVAL (DAYS) BETWEEN TWO NMNRS IN AIRCRAFT  
LONGEST INTERVAL (DAYS) BETWEEN TWO NMNRS IN AIRCRAFT

**FIG. 10B**

NUMBER OF YEARS WITH 0 (1, 2, 3, 4, 5, 6 OR 7) SDRS  
NUMBER OF YEARS WITH 0 (1, 2, 3, 4, 5, 6 OR 7) UELS  
NUMBER OF YEARS WITH 0 (1, 2, 3, 4, 5, 6 OR 7) MAJORS

**EPISODE DEPENDENT VARIABLES ("X" BEING USER SELECTABLE)**

DURATION IN DAYS OF EPISODE X  
COMBO CODE OF EPISODE X  
NATURE OF CONDITION OF FIEST RELATED SDR IN EPISODE X  
PRECAUTIONARY PROCEDURE OF FIRST RELATED SDR IN EPISODE X  
DOD OF FIRST RELATED SDR IN EPISODE X  
INTERVAL BETWEEN FIRST AND SECOND RELATED SDR IN EPISODE X  
NUMBER OF SDRS IN EPISODE X  
SHORTEST INTERVAL BETWEEN 2 ANY SDRS INSIDE EPISODE X  
NUMBER OF UELS IN EPISODE X  
SHORTEST INTERVAL BET ANY TWO UELS IN EPISODE X  
NUMBER OF MAJORS IN EPISODE X  
SHORTEST INTERVAL BET ANY TWO MAJORS IN EPISODE X  
NUMBER OF ROUTINES IN EPISODE X  
SHORTEST INTERVAL BET ANY TWO ROUTINES IN EPISODE X  
NUMBER OF NMNRS IN EPISODE IN EPISODE X  
SHORTEST INTERVAL BET ANY TWO NMNRS IN EPISODE X

(NOTE: THE ABOVE VARIABLES ARE OUTPUT FOR EACH EPISODE UP TO THE XTH EPISODE.)

INTERVAL BETWEEN EPISODE X AND EPISODE X-1 (EG: IF X=3 THEN THE INTERVAL IS MEASURED BETWEEN THE FIRST EPISODE AND THE SECOND AND ANOTHER INTERVAL IS MEASURED BETWEEN THE SECOND EPISODE AND THE THIRD).

**WINDOW DEPENDENT VARIABLES**

NUMBER OF SDRS IN WINDOW  
SHORTEST INTERVAL BET ANY TWO SDRS IN WINDOW  
NUMBER OF RELATED SDRS IN WINDOW  
SHORTEST INTERVAL BET ANY TWO RELATED SDRS IN WINDOW  
NUMBER OF EPISODES IN WINDOW  
SHORTEST INTERVAL BET ANY EPISODES IN WINDOW  
NATURE OF CONDITION OF FIRST RELATED SDR IN WINDOW  
PRECAUTIONARY PROCEDURE OF FIRST RELATED SDR IN WINDOW  
NUMBER OF UELS IN WINDOW  
SHORTEST INTERVAL BET ANY TWO UELS IN WINDOW  
NUMBER OF MAJORS IN WINDOW  
SHORTEST INTERVAL BET ANY TWO MAJORS IN WINDOW  
NUMBER OF ROUTINES (TYPE = 3) IN WINDOW  
SHORTEST INTERVAL BET ANY TWO ROUTINES (TYPE = 3) IN WINDOW  
NUMBER OF NMNRS (TYPE = 4) IN WINDOW  
SHORTEST INTERVAL BET ANY TWO NMNRS (TYPE = 4) IN WINDOW

**FIG. 10C**



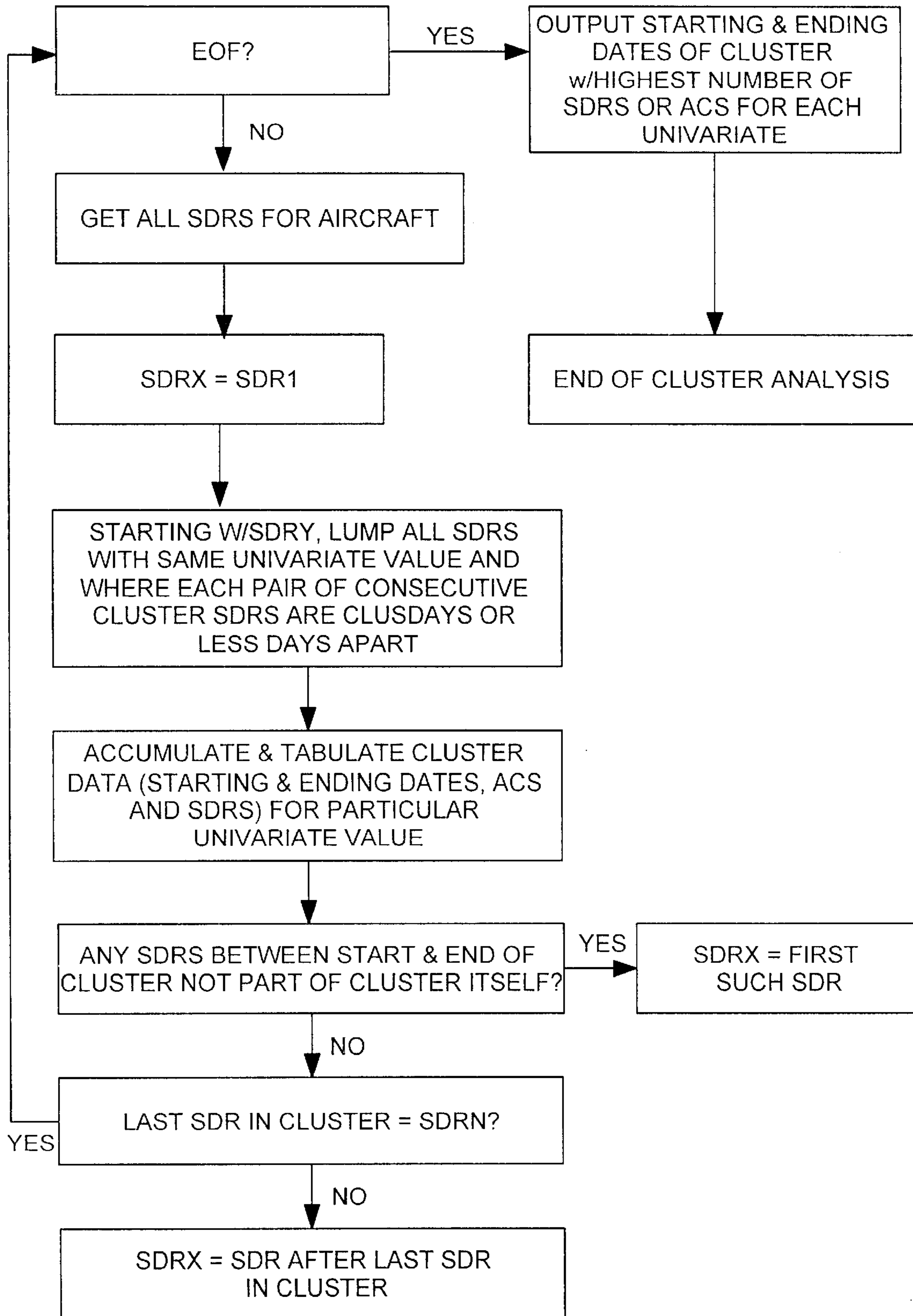


FIG. 11A

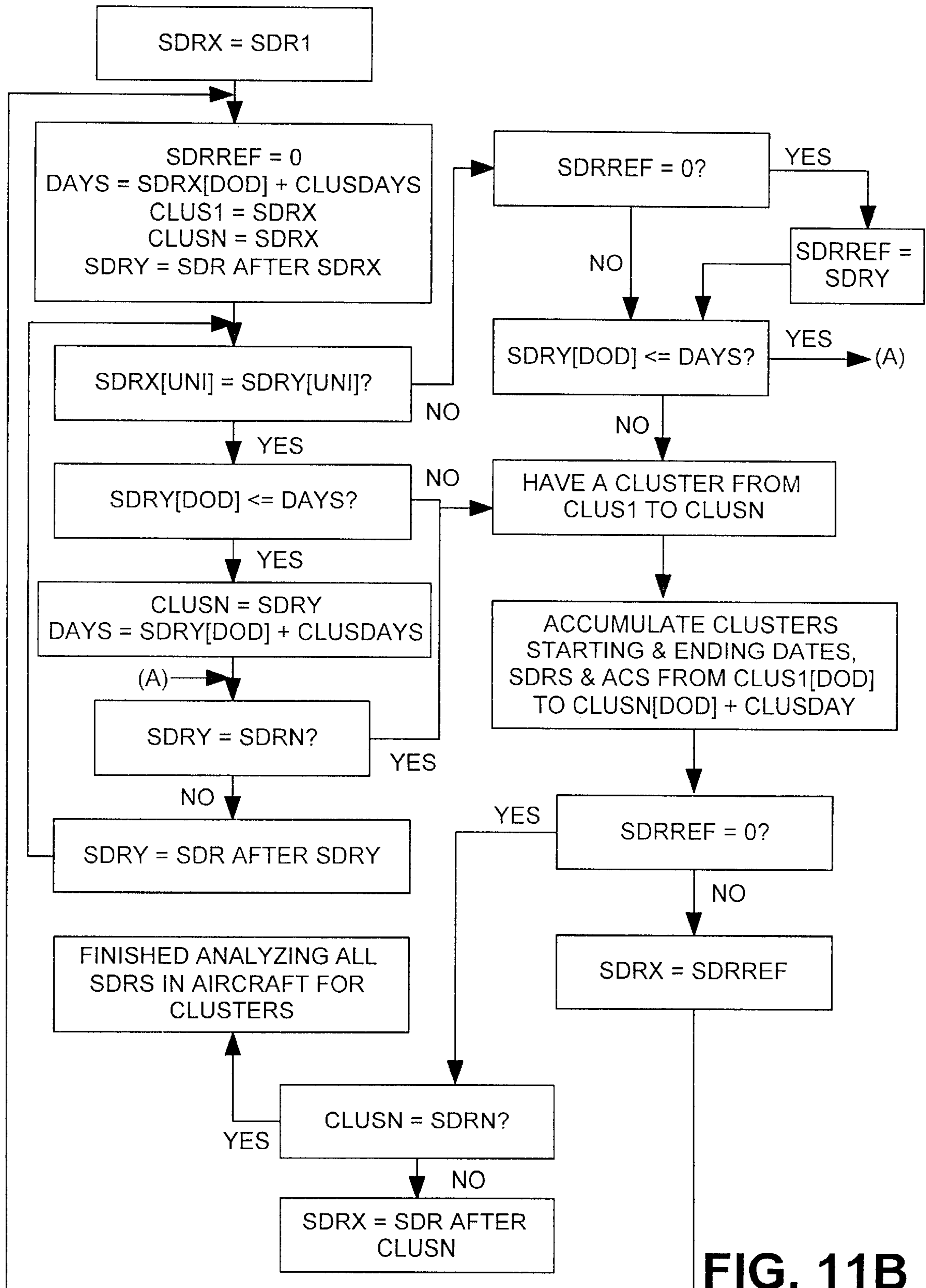


FIG. 11B

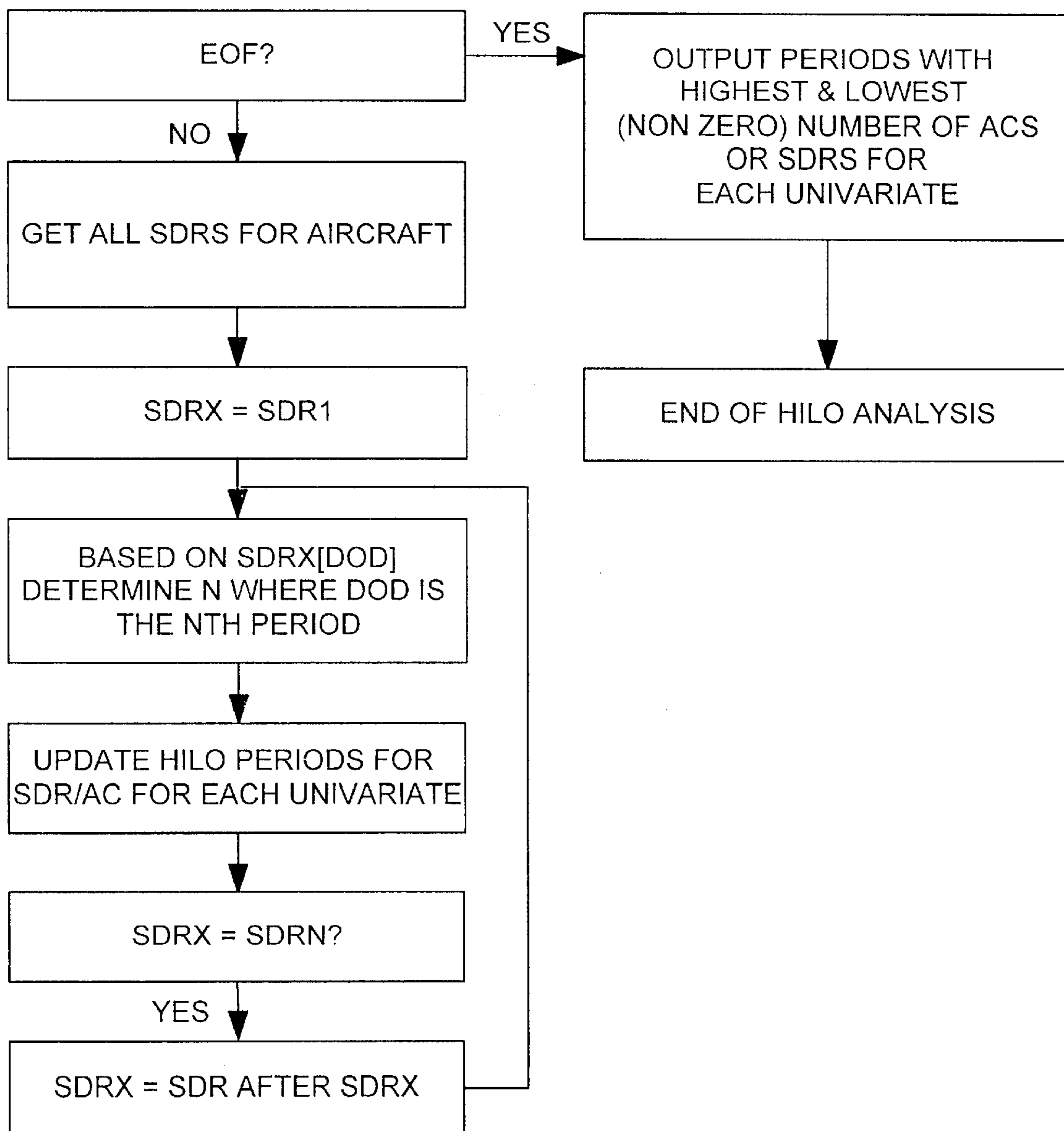
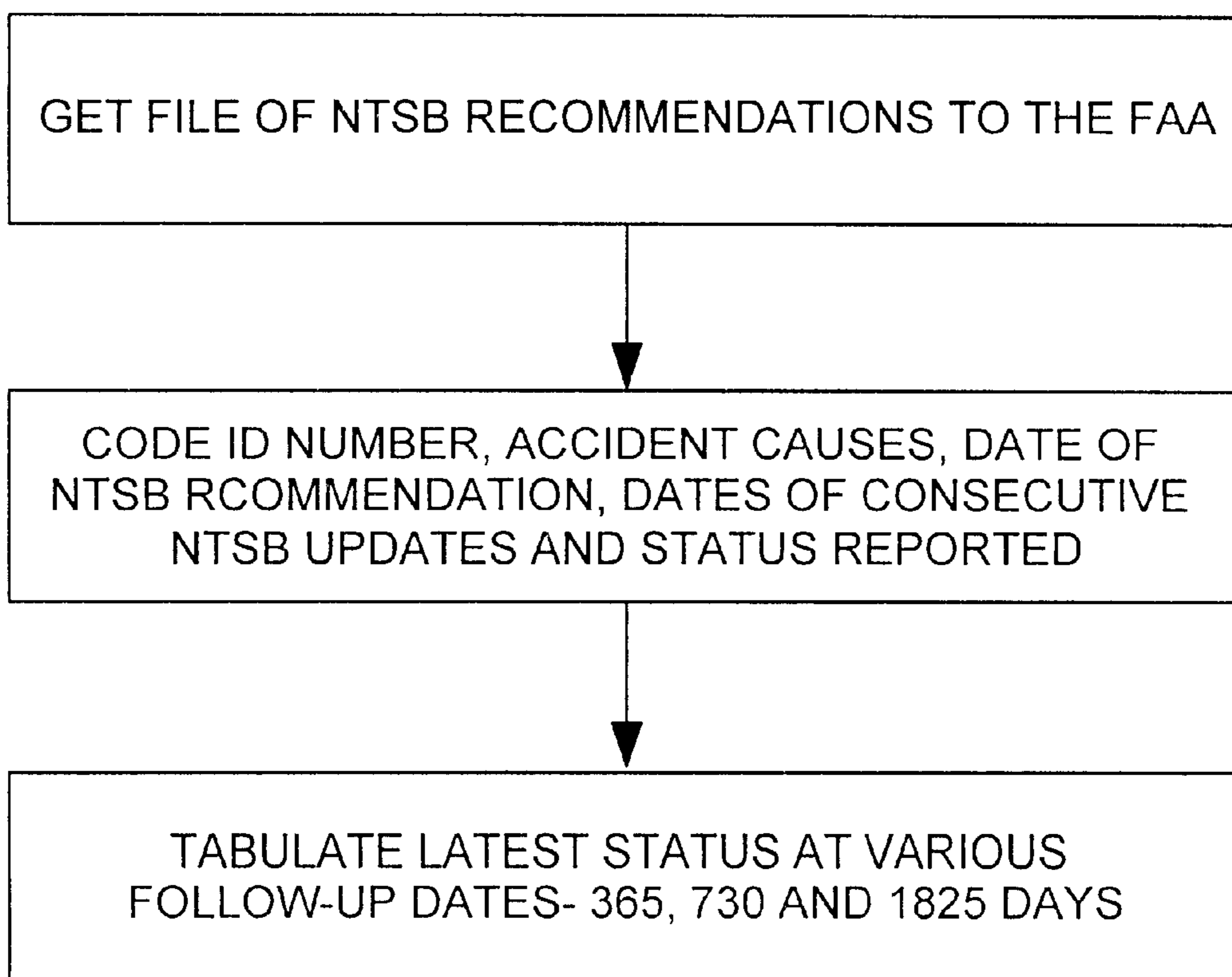
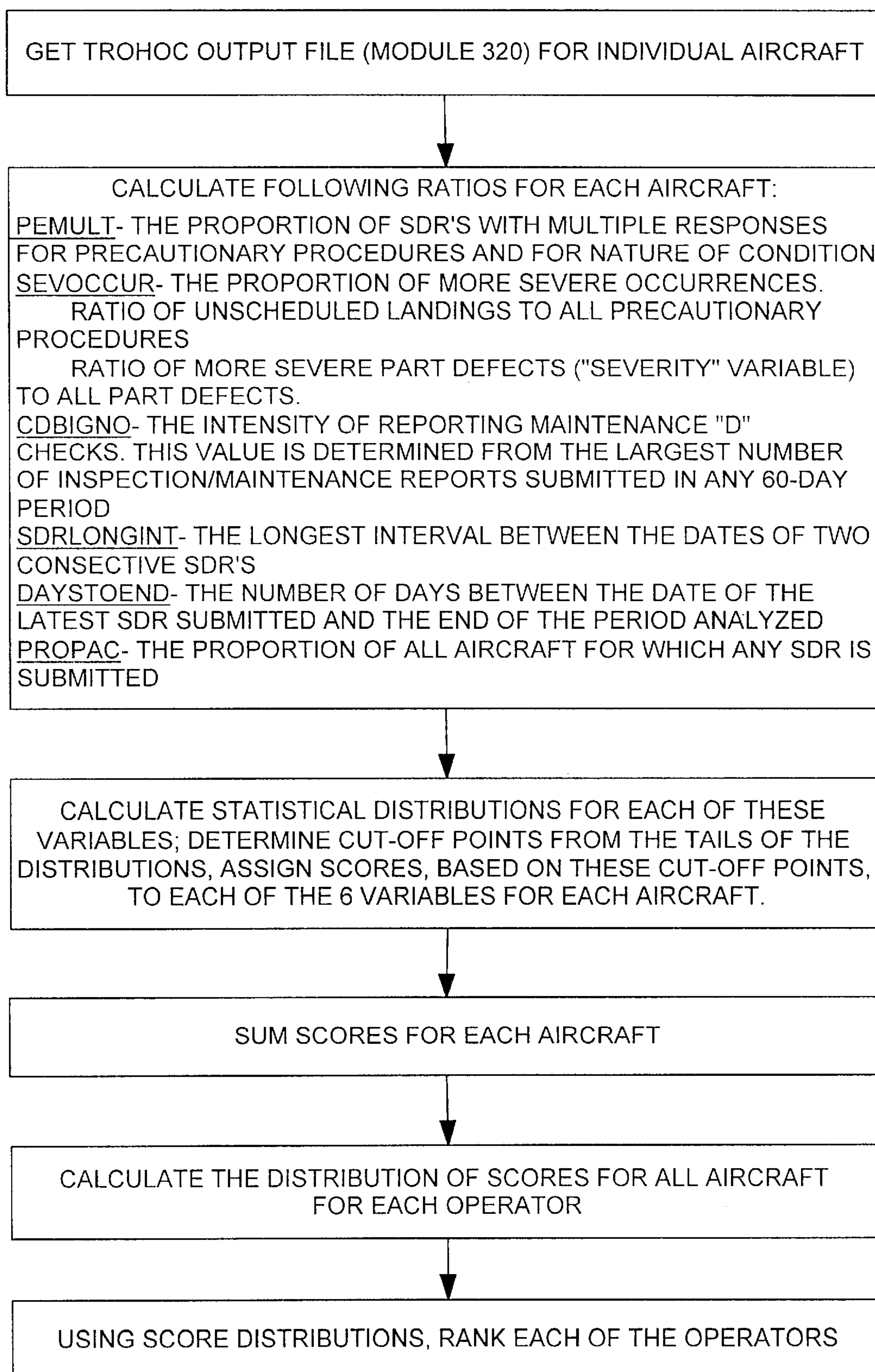
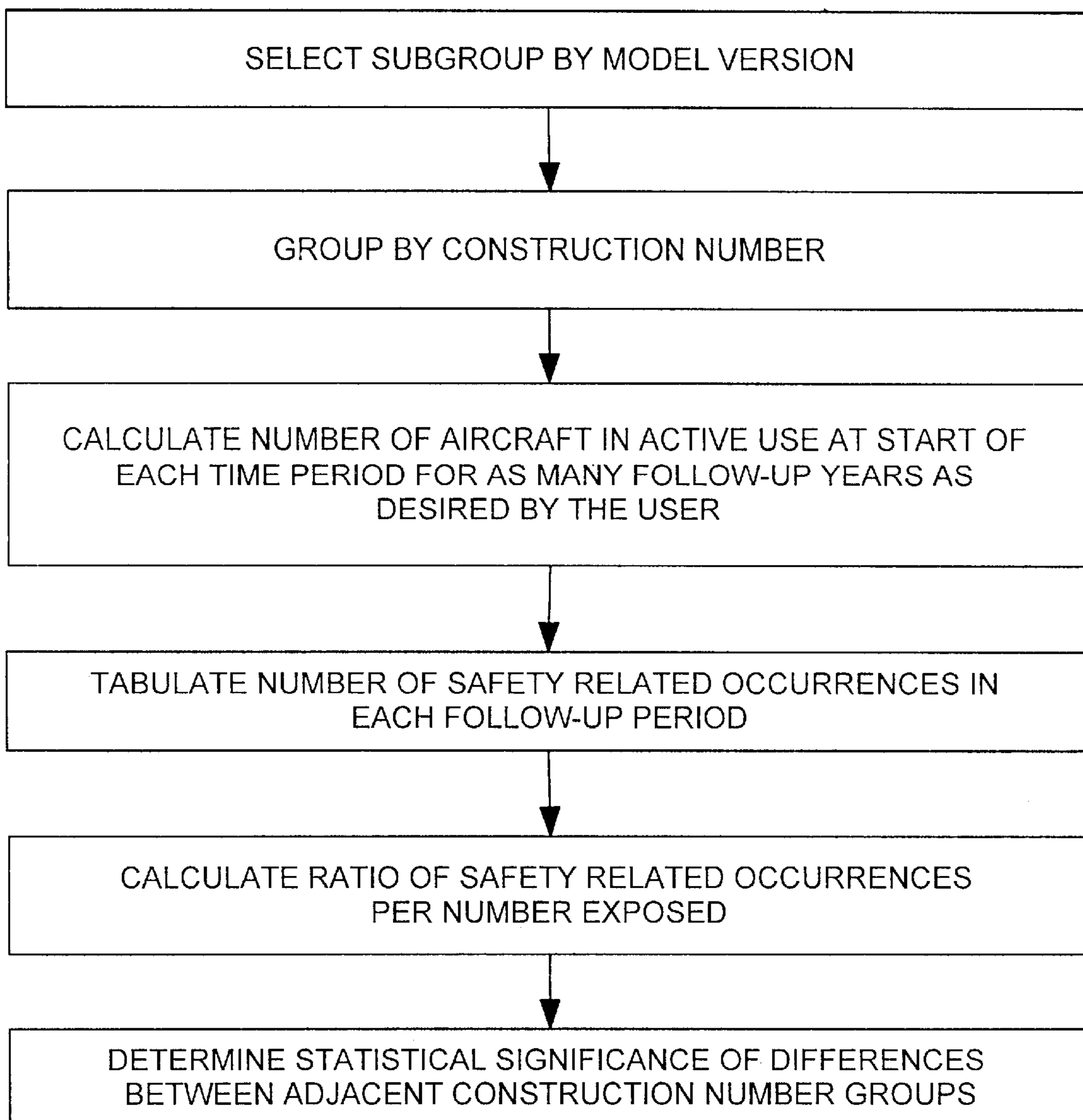


FIG. 12



**FIG. 13**

**FIG. 14**

**FIG. 15**

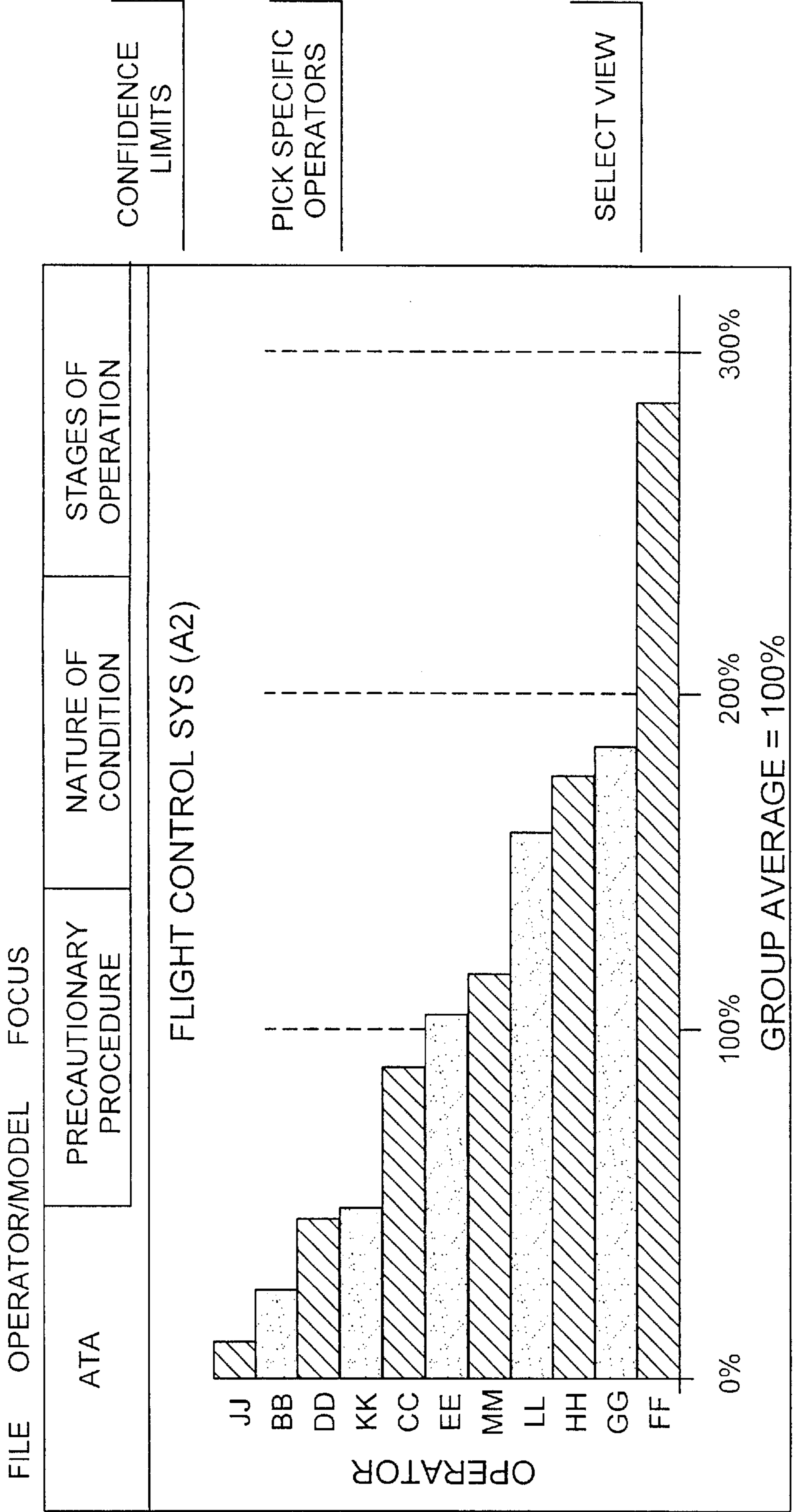


FIG. 16A

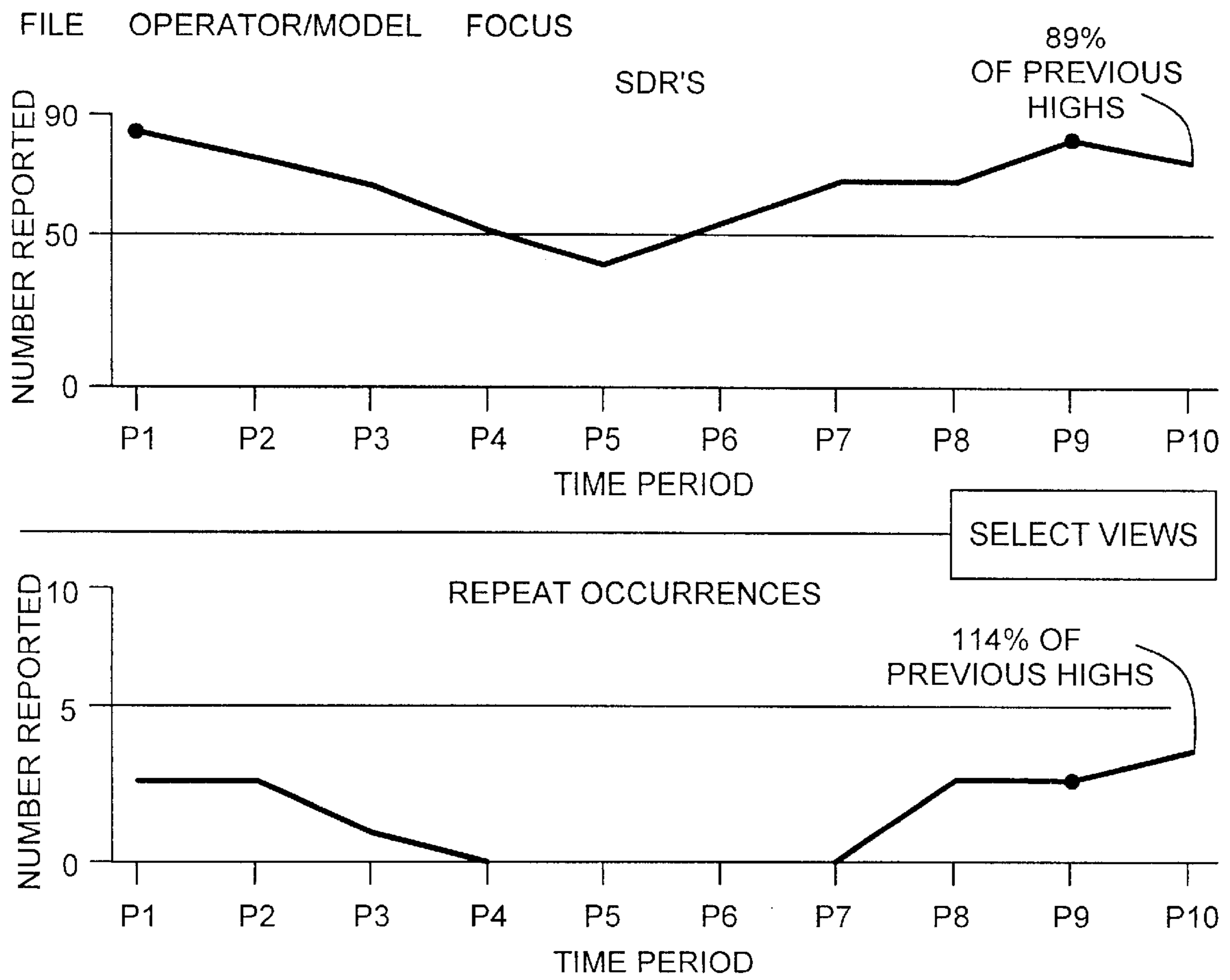
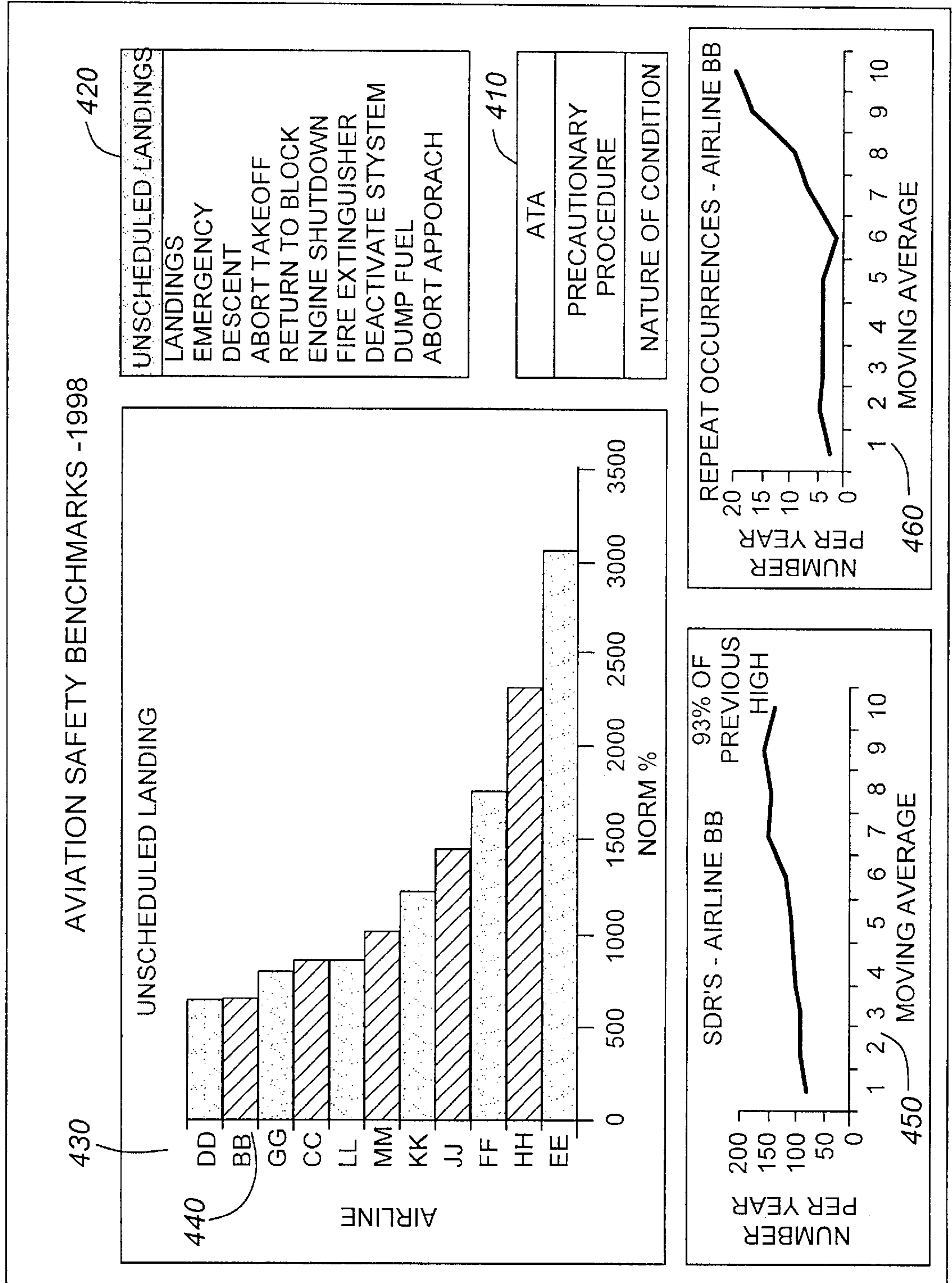


FIG. 16B





**FIG. 16C**

## INFORMATION SYSTEM AND METHOD USING ANALYSIS BASED ON OBJECT- CENTRIC LONGITUDINAL DATA

### TECHNICAL FIELD

This invention relates generally to a computerized information system and method using object-centric virtual database(s) and analyses which are advantageously suited to transportation safety applications, such as for the aviation industry (in which case the aircraft may be the unit of observation i.e. "object" referred to herein), as well as for health and other safety monitoring applications.

### BACKGROUND

As is true for many transportation and health areas, the aviation industry generates a number of different reports relating to a variety of safety-related occurrences which are available to the public (either through the Internet or on request to the source). Appendix A herein sets out a summary of several sources of these reports and the meaning of various terms used in the aviation industry in relation to reporting. Individual aircraft are identified in accident reports, incident reports, mechanical reliability reports of failures (also referred to as service difficulty reports or "SDRs") and engine reliability reports. In some other available reports pertinent information is provided but not in relation to a specific aircraft. For example, as stated in Appendix A, reports in the Aviation Safety Report System (ASRS) do not identify individual aircraft. In addition, Airworthiness Directives (and the automated exemption lists which may be provided therein) stipulate generally directed requirements for inspecting and/or fixing potential problems. Similarly, National Transportation Safety Board (NTSB) recommendations to the Federal Aviation Authority (FAA) and their outcomes, as well as FAA enforcement data on regulatory violations, provide additional sources of safety-related occurrences. Examples of some other safety-related data types include pilot factors, airport and air traffic management.

There is no automated means available to analyse multiple records from such publicly available sources for objects such as individual aircraft. Nor is there available any means for performing statistical analyses of trends and/or rates of non-accident occurrences (examples of which are SDRs, engine reliability reports and incidents) on such multiple records across various files let alone the same file for an individual object such as an aircraft. Consequently, the existing aviation safety systems cannot identify single aircraft with multiple problems and, because they do not identify rates, they do not provide any measure of risk which would permit a comparison of models or operators or identification of changes in trends.

Accordingly, there is a need for means to perform longitudinal analyses on individual safety/health-related objects (such as an aircraft or a patient) to enable a comparison of different groups of objects (such as aircraft models and operators). In particular, for example, there is a need for a means of standardizing public and/or private data providing non-accident safety-related information such as mechanical difficulties, as well as operational data, relating to aircraft and for analyzing such data on an object-centric basis to identify and predict potential problem areas and risks. The term "object" includes anything physical such as an aircraft, nuclear reactor or other environmental hazard for which safety-related events are monitored as well as anything

which is the subject of events such as a drug or treatment for which the events to be monitored may include reactions to the drug or a disease for which the events may include symptoms.

### SUMMARY OF THE INVENTION

In accordance with the invention there is provided an information system for analyzing data comprised of events pertaining to an object class (e.g. aircraft). The system comprises a data access component configured for accessing a database comprising at least one set of data records (service difficulty reports) whereby each data record pertains to an event for an individual object (e.g. an individual aircraft) and comprises a plurality of data fields, at least one of the data fields comprising an identifier identifying one individual object. A user interface component receives user-selected criteria for field values of the data fields. A selection component is configured for selecting those of the data records which correspond to the user-selected criteria. An analysis component is configured for analyzing the data records including identifying the selected data records according to a chronological sequence of events for individual objects covered by the selected data records, whereby each individual object covered by the selected data records is associated with a longitudinal set of data records, and deriving output data for the events from the longitudinal sets of data records.

Preferably, the data fields comprise a plurality of identifiers and a preprocessor component identifies multiple sub-databases from the selected data records whereby each sub-database comprises data records identified by one of the identifiers. Preferably, a plurality of sets of data records are provided, each being derived from a different source, whereby the sets of data records are integrated to form the database. The information provided by one set of data records may be used to supplement other data records of the database and the information provided by another one of the sets of data records may be used to correct erroneous data field values in data records obtained from any source.

A graphizer output component is preferably provided for graphically displaying the output data by multi-result inter-related graphs. The analysis component may be configured for identifying chronological trends for one or more individual objects and/or data records, for surveiling the events on a chronological basis for one or more individual objects, for standardizing the data reports and individual objects as between the different originating sources thereof (e.g. based traffic patterns for each individual aircraft and the types of aircraft models of each originating source), for comparing on a chronological basis and measured from a user-selected event the events pertaining to one individual object and the events pertaining to a user-selected comparison group of objects, for normalizing the field values for a set of data fields and outputting the resulting normalized data, for identifying related data records of the data records, for identifying a statistically high number of events for an individual object within a designated time period and/or for rating the originating sources of the data records on the basis of the diligence of the originating sources in reporting events.

### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in greater detail with reference to the attached drawings wherein:

FIG. 1 is a general block diagram of the main components of an information system in accordance with the present

invention, the illustrated system being an aviation information system using aircraft-centric databases and analyses;

FIG. 2 is a further block diagram of the system shown by FIG. 1 with more detail shown therein with respect to the inputs and outputs of the main components;

FIG. 3 is a general flow chart diagram showing steps of the information system and method from the user's selection inputs to the presentation of the output tables and graphs;

FIGS. 4a through 4e together form a flow chart diagram of steps performed by the selection filter component 200 of the illustrated information system;

FIG. 5 is a flow chart diagram showing steps performed by the analysis modules 310, 320, 330, 340 and 360 for calculating repeats for an aircraft;

FIGS. 6a and 6b are flow chart diagrams showing steps performed by the SURVEIL module 310 and FIGS. 6c and 6d illustrate some ways comparison periods land moving averages could be constructed which in turn are analysed by the SURVEIL module 310;

FIGS. 7a, 7b, 7c and 7d are flow chart diagrams showing steps performed by the STANDARDIZATION module 320;

FIGS. 8a and 8b are flow chart diagrams showing steps performed by the TROHOC module 330;

FIG. 9 is flow chart diagram showing steps performed by the TABULATE module 340;

FIG. 10(a) is a flow chart diagram showing steps performed by the ALF module 350 and

FIGS. 10(b) and 10(c) display an exemplary descriptive listing of output produced by this module;

FIGS. 11a and 11b are flow chart diagrams showing steps performed by the CLUSTER module 360, with FIG. 11a providing an overall view of the process and FIG. 11b providing a more detailed view thereof;

FIG. 12 is a flow chart diagram showing steps performed by the HILO module 370;

FIG. 13 is a flow chart diagram showing steps performed by the RCO module 380;

FIG. 14 is a flow chart diagram showing steps performed by the DILIGENCE module 390;

FIG. 15 is a flow chart diagram showing steps performed by the COHORT module 395; and,

FIGS. 16(a)–16(c) are exemplary depictions of output graphs produced by the graphizer component of the system, of which FIG. 16(a) is a single graphic output, FIG. 16(b) is a two-graph output and FIG. 16(c) is a three-graph output.

### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 shows, in general block diagram form, the main components of an aircraft-based (i.e. aircraft-centric) aviation information system and method in accordance with the present invention. In this embodiment the object class is aircraft and an individual object is an individual aircraft. Events pertaining to individual aircraft are reported in service difficulty reports (SDRs), being data reports herein.

The components 100, 200, 300, 400 are in the form of computer programs. A preprocessor component 100 manages, massages, cleans, links and sorts the data provided by SDRs, and other safety-related data from accident/incident reports and other sources (e.g. engine reliability), into six master database files 150 (see FIG. 2), as detailed below, which are developed by the preprocessor 100 from such data. A selection filter component 200 is user selected and controlled and includes a database access component for

selecting aircraft and/or SDRs, according to user-specified criteria, from any one of the six master database files 150 for purposes of further analysis. The resulting selected data produces an intermediate (ie temporary) data file 250 which is used by an analyses component 300. The analyses component 300 comprises several analysis subcomponents 310, 320, 330, 340, 350, 360, 370, 380, 390 and 395 (FIG. 2) referred to herein as analysis modules. The modules 310, 320, 330, 340, 350, 360, 370 and 395 use the aircraft (referred to herein as "AC") as a basic unit of observation (i.e. the aircraft is the object) together with user inputted criteria to perform specific analyses. Analysis module 380 operates on the individual NTSB recommendations for which the courses and outcomes of FAA implementations are tracked. Analysis module 390 operates on the individual operators for which various statistical performance measures are used to derive an aggregate score. Two of the analysis modules viz, modules 330 and 350, produce longitudinal data files comprising one record per individual aircraft and, therefore, aircraft-based output. A graphizer component 400 outputs the results of analyses selected by the user and this output is provided in various formats including a multi-graphical display as shown, for example, by FIGS. 16(b) and (c).

SDRs form the workhorse from which most of the analysis modules derive results. In fact, each aircraft has a minimum of one SDR. Each SDR comprises the following fields: AC3 (Model, BTS Model and Opcode), SERAC (Serial number), NNUM (Nnumber), Kind, Year built, OTH (Opcode, Opcode and Model), DOD, DOR, ALT (BTS Model, Model and BTS Model), Nature of Condition, Precautionary Procedure, Severity, Stage of Operation, ATA, Construction number, Engine, Crash report status and Incident report status. For illustration purposes, some of the values associated with some of these fields are listed in Appendix B herein. The preprocessor component 100 categorizes, sorts and identifies each SDR according to six different formats (each format corresponding to one of the six files of a master database 150) as illustrated below in Table 1 and each aircraft is thereby associated with a set of SDRs according to a given set of identifiers (i.e. per the first column of Table 1).

TABLE 1

AC IDENTIFIED BY	AC CATE- GORIZED AND SORTED BY	AC3	OTH	ALT
MODEL, SERAC	MODEL, SERAC, DOD	MODEL	OPCODE	BTS MODEL
BTS MODEL, SERAC OPCODE, SERAC	BTS MODEL, SERAC, DOD OPCODE, SERAC, DOD	BTS MODEL	OPCODE MODEL	BTS MODEL
MODEL, SERAC, NNUM	MODEL, SERAC, NNUM, DOD	MODEL	OPCODE	BTS MODEL
BTS MODEL, SERAC, NNUM	BTS MODEL, SERAC, NNUM, DOD	BTS MODEL	OPCODE	MODEL
OPCODE, SERAC, NNUM	OPCODE, SERAC, NNUM, DOD	OPCODE	MODEL	BTS MODEL

The value sets associated with MODEL, BTS MODEL and OPCODE are listed in Appendix B herein. Each airplane's serial number is assigned by the aircraft's manufacturer and remains unchanged with the plane through its operational history. Its registration number (also known as the tail number) is assigned by the US Department of

Transportation. Since a plane can be owned or operated by different owners or operators over time, its registration number can change over time. Serial and registration number assignments for USA-registered aircraft also apply to non-USA registered aircraft.

The data gathered by the preprocessor component **100** may be obtained from public or private sources or a combination of both. The most important data gathered by it in the embodiment described herein are Service Difficulty Reports (SDRS) which are reports of each particular occurrence involving a mechanical difficulty pertaining to a particular aircraft. SDRs are legally required by the Federal Aviation Administration (FAA) for each and every safety related mechanical difficulty involving any USA-registered airplane. The seriousness of the mechanical difficulties reported in SDRs range from broken in-cabin passenger light bulbs at the low end of the seriousness spectrum to engine failures and cockpit smoke/fires at the other end. Appendix B herein lists some of the values for specific information fields provide by an SDR. The FAA makes SDRs readily available to the public.

For the system embodiment described herein the SDRs are compiled into a combined safety database of the preprocessor component **100**. Historical SDR data was obtained from the FM's Oklahoma City office and current SDRs are downloaded directly from the FAA's website and incorporated by the preprocessor component **100** on a regular basis. The preprocessor component **100** adds certain aircraft data to each SDR such as the year it was built, its construction number and engine type all of which are stored and updated in a Census file maintained by the system.

The Census file is a master file containing validated information for aircraft (derived from SDRs and production lists), including the serial and registration numbers of the aircraft, and this information is used to validate new records received by the system. Other information kept in the Census file includes the manufacturer's construction number for the aircraft, the year in which the aircraft was built, the model and/or version identifier for the aircraft, any other identifying feature associated with the aircraft that may be desired to be tracked such as the type of wiring of the aircraft and activity history for the aircraft such as engine replacements.

A Change file keeps track of aircraft having inaccurate or garbled identifiers and their corrected identifiers. It also keeps track of inaccurate or garbled non-identifying data values and their corrected values. Other information may be added to the Census and Change datasets if desired.

In addition to gathering report data, the preprocessor component **100** harmonizes the fields in each SDR according to system definitions (model name and version as well as operator name, etc.), deletes duplicates, corrects errors and links (ie: matches) the SDR to aircraft identification data. Such verification is done by first comparing the identifier with those in the Change file and then with the Census file. Both the Change and Census datasets are updated each time a new SDR is integrated with a master SDR file of the master database **150**.

Aviation Safety Report System (ASRS) reports are anonymized and unlike the SDRs or accident/incident reports, do not identify the aircraft for which the report was generated (specifically, the operator and serial/registration numbers for the aircraft are not provided). For this reason the preprocessor component **100** maintains the ASRS data in a separate dataset from the master database **150**.

Another smaller dataset is also maintained by the preprocessor component **100** of the illustrated embodiment,

namely an Operator/Model Exposure and Costs (OMEC) dataset. The preprocessor component **100** tabulates departures, hours in flight, hours ramp to ramp, aircraft miles, passenger miles, aircraft days, aircraft census (mean number in service), costs and individual aircraft by age or other individual characteristic for each of the largest operators (this being about 100 operators in the embodiment described herein) and aircraft models using data collected by the Bureau of Transportation Statistics (BTS).

In addition, an Engine Reliability Dataset (ERD) is maintained by the preprocessor component **100** and this data is obtained from the ASY division of the FAA. The ERD dataset contains 1998 and 1999 engine types used for each aircraft model and by operator. It also contains engine hours and aircraft census as well as engine failures and engine changes. The ERD has two uses. Firstly, it gives more complete data on engine failures than SDRs and secondly, it gives aircraft census monthly numbers for number of aircraft and flight hours by model/version by operator.

Other public and/or private databases may be integrated into the preprocessor component **100** if and as desired. For example, private data such as Flight Oriented Quality Assurance (FOQA) data consisting of the output from the Flight Data Recorders (FDRs) (providing more data on engine performance and pilot behaviour) could be incorporated. Such added data would then be integrated into the system for use by component **300**.

The selection filter component **200** selects a dataset from the database maintained by the preprocessor component **100** on the basis of user-specified criteria. The user-selectable criteria provided in the illustrated embodiment are the following:

1. Aircraft report history—permits report activity within five specified time periods and by minimum/maximum number of reports in each period.
2. Presence or absence of SDRs before the minimum date of the first specified time period from the first criteria above
3. Presence or absence of SDRs after the maximum date of the first specified time period from the first criteria above
4. Model—for example, DC9, B737, etc.
5. Version—for example, DC9-30, B737-300, etc.
6. Manufacturer—for example, Boeing, Airbus, etc.
7. Specific operators—for example, United Airlines, USAir, American Airlines, etc.
8. Operator group—major, national, regional or other.
9. SDR's—only for specified operator or all SDR's for the aircraft.
10. Type
11. Nature of condition
12. Precautionary procedure
13. Severity
14. Stage of operation
15. select 2 char ATA code on SDR basis
16. select 4 char ATA code on SDR basis
17. select AC with user selected 2 char ATA code (and accept all other SDRs in AC)
18. select AC with user selected 2 char ATA code (and reject all other SDRs in AC)
19. select AC with user selected 4 char ATA code (and accept all other SDRs in AC)
20. select AC with user selected 4 char ATA code (and reject all other SDRs in AC)
21. minimum/maximum Year built
22. minimum/maximum time between DOD and DOR
23. Select all SDRs on same day or select first SDR of similar SDRs occurring on same day
24. Construction number range

25. Crash report(s) status
26. Incident report(s) status
27. Engine manufacturer and model
28. Serial number range
29. Wiring type

Users may modify the twenty nine (29) criteria listed above through the user interface. Criteria number one allows users to compare different aircraft with similar report histories. This is pertinent because some aircraft are not in continuous use during the entire time period of observation. An airplane may be withdrawn from use, stored or sold outside of the USA in which case SDRs are not legally mandated for any mechanical problems it may encounter. This first criteria provided to the user allows the user to make comparisons on the level or intensity of SDR activity by specifying a minimum and maximum number of SDRs for any user definable arbitrary period of time.

Criteria numbers two and three presented to the user through the user interface allow the user to select or ignore aircraft with SDR activity before the first period's minimum date or after the same period's maximum date. The same two criteria also allow the user to select the aircraft regardless of any SDR activity before the first period's minimum date or after the same period's maximum date.

A text analysis and a keyword search are also provided as user definable (not selectable) fields via the user interface. Of course, different and/or additional selectable and definable fields could be provided by the system if desired. A general flow chart diagram showing steps of the information system and method from the user's selection inputs to the presentation of the output tables and graphs is provided by FIG. 3.

The selection filter component **200** creates an intermediate (i.e. temporary) data file containing a collection of aircraft all meeting an input set of user-specified criteria. A user interface component (e.g. a graphical user interface (GUI)) receives, from the user, a set of selectable criteria as set out above (i.e. items listed as 1-29 and the text analysis and a key word search) which the selection filter component **200** uses to select the specific file of the master database **150** which is linked to such aircraft and also the aircraft and SDRs meeting such criteria. The selection filter compiles the resulting data identified from the user-specified criteria into an intermediate data file **250**. FIGS. 4a through 4e together form a flow chart diagram of the steps performed by the selection filter component **200** of this embodiment.

The analysis modules **310-370** and **395** each include a longitudinalizer function which gathers all the SDRs having the same identifying data, per column 1 of Table 1, into virtual storage. At this point the analysis module (i.e. one of **310-370** or **395**) has a virtual aircraft with virtual SDRs, representing a chronological sequence of events for an individual aircraft. The analysis module then analyses that virtual aircraft and temporarily stores the results of the analysis in memory. The virtual aircraft with its virtual SDRs are then cleared from the computer's memory and the program module repeats the cycle by gathering the SDRs for the next aircraft. The analysis results for each aircraft are collated or compared and when all of the aircraft in the intermediate file **250** have been analysed accordingly the analyses of all the aircraft are output into another intermediary file **397** to be presented to the user by means of the graphizer **400**.

The analyses component **300** includes a GUI which allows the user to select values for variables which are specific to each analysis module which is to perform. The user selects the analysis modules which the user wishes to

run and they are run (performed) in the system in numerical order from module **310** to module **395**. Each of the analysis modules **310** through **370** and **395** analyses the intermediary file **250** produced by the selection component **200**. These 5 modules (also referred to as subcomponents) use the aircraft (AC) as the basic unit of observation and two of these also produce aircraft-centric output as illustrated in Table 2 below.

TABLE 2

SUB COMPONENT	SUBCOMPONENT NAME	AC UNIT OF OBSERVATION	AC BASED OUTPUT
310	SURVEIL	Yes	No
320	STANDARDIZATION	Yes	No
330	TROHOC	Yes	Yes
340	TABULATE	Yes	No
350	ALF	Yes	Yes
360	CLUSTER	Yes	No
370	HILO	Yes	No
380	RCO	No	No
390	DILIGENCE	No	No
395	COHORT	Yes	No

Analysis modules **310-370** and **395** are based on analysing variates which simply put, are specific values for specific fields. For example, the field TYPE has four variates, TYPE=1, TYPE=2, TYPE=3 and TYPE=4. There are two kinds of variates, namely, univariates and bivariates which are detailed below.

Univariates: These fields, which include Type, Nature of Condition, Precautionary Procedure, Stage of Operation, Severity, Year Built, AC3, OTH, ATA2 Char and ATA4 Char for this embodiment, are analysed by calculating aircraft-centric measurements for specific values of these specific fields.

Bivariates: These fields, which include Nature of Condition by ATA, Precautionary procedure by ATA, Severity by ATA, Precautionary Procedure by Nature of Condition, ATA by Nature of Condition, ATA by Precautionary Procedure, ATA by Severity and Nature of Condition by Precautionary Procedure for this embodiment, are analysed by calculating occurrences for specific values of these specific field pairings. Table 3 below identifies the analysis modules which use the univariates and bivariates.

TABLE 3

SUB-COMPONENT	SUBCOMPONENT NAME	UNIVARIATE	BIVARIATE
310	SURVEIL	Yes	Yes
320	STANDARDIZATION	Yes	Yes
330	TROHOC	Yes	Yes
340	TABULATE	Yes	Yes
350	ALF	No	No
360	CLUSTER	Yes	Yes
370	HILO	Yes	Yes
380	RCO	No	No
390	DILIGENCE	No	No
395	COHORT	Yes	Yes

Aircraft-centric measurements include calculating SDRs, ACs, repeats and intervals for variates (either univariates or bivariates or both according to the user's selections). An aircraft's SDR count is a simple count of the number of SDRs the aircraft has for each variate. Table 4 below illustrates five SDRs all with the same identifying data (as per the first column of Table 1) which are linked to the same virtual aircraft (e.g. referred to herein as aircraft 1 or "AC1")

by a longitudinalizer function. An analysis module then performs aircraft-centric measurements (SDRs, ACs, repeats and intervals) on this virtual aircraft.

The first aircraft-centric measurement involves SDR measurements. The SDR measurement is calculated for each variate by counting the number of SDRs in the aircraft with that particular variate. For example, AC1 has three SDRs with TYPE=2 but no SDRs with TYPE=4.

The second aircraft-centric measurement also involves aircraft measurements.

The aircraft measurement is calculated for each variate by assigning the value one (1) for each variate for any number of SDRs with that particular variate. For example, AC1 will register one (1) AC for each of TYPE=1, TYPE=2 and TYPE=3 but none for TYPE=4.

Each of Tables 4 and 5 below show data linked to one specific aircraft.

TABLE 4

SDR Sequence	TYPE
1 <sup>st</sup>	1
2 <sup>nd</sup>	2
3 <sup>rd</sup>	3
4 <sup>th</sup>	2
5 <sup>th</sup>	2

TABLE 5

	SDR count	AC count
TYPE 1	1	1
TYPE 2	3	1
TYPE 3	1	1
TYPE 4	0	0

Tables 6 and 7 show how the SDR and AC counts change when the system examines two aircraft instead of one.

TABLE 6

AC ID	SDR Sequence	TYPE
1 <sup>st</sup>	1 <sup>st</sup>	1
1 <sup>st</sup>	2 <sup>nd</sup>	2
1 <sup>st</sup>	3 <sup>rd</sup>	3
1 <sup>st</sup>	4 <sup>th</sup>	2
1 <sup>st</sup>	5 <sup>th</sup>	2
2 <sup>nd</sup>	1 <sup>st</sup>	1
2 <sup>nd</sup>	2 <sup>nd</sup>	2
2 <sup>nd</sup>	3 <sup>rd</sup>	1
2 <sup>nd</sup>	4 <sup>th</sup>	4

TABLE 7

	SDR count	AC count
TYPE 1	3	2
TYPE 2	4	2
TYPE 3	1	1
TYPE 4	1	1

The third aircraft-centric measurement involves repeats. A repeat occurs when two SDRs having the same variate (examples of this are where two SDR's have the Variate TYPE=1 or where both have the variate PRECAUTIONARY PROCEDURE=4) have DODs (dates of difficulty) within a user-defined lapsed time, meaning that the SDRs in

question are not far apart on a time line. No repeat is considered to have occurred where two SDRs have close DODs but different variates (eg where one has the variate TYPE=1 and the other has the variate TYPE=3). It is possible for a repeat to occur between an aircraft's third SDR and its eleventh SDR, for example, and this would most likely occur where an aircraft has many SDRs clustered together in a short time. To be considered a repeat the SDRs themselves are not required to be consecutive because a repeat is a measure of time and not the order of an aircraft's SDRs. FIG. 5, in the form of a flow chart, illustrates the steps performed by the analysis modules 310, 320, 330, 340 and 360 for calculating repeats for an aircraft.

The analysis component 300 permits the user, by means of the GUI, to define a minimum and maximum number of days (referred to herein as RPTX and RPTY, respectively) between the DODs for two SDRs in order to be considered a repeat. Two SDRs having DODs which are less than RPTX days apart or more than RPTY days apart are not considered to constitute a repeat. By default, in the preferred embodiment, two SDRs having DODs of the same day are defined to be exactly one day apart. However, the user may change this definition (by means of the GUI in SELECTION component 200) so that such SDRs are defined as being zero days apart. The latter definition would enable a user to distinguish between two SDRs having DODs occurring on the same day from two SDRs whose DODs occur on consecutive days.

The fourth aircraft-centric measurement involves intervals. The definition of an interval for a particular variate is defined to be the shortest repeat (applying the same boundaries as those set for repeats viz. more or equal to RPTX and less than or equal to RPTY) for that variate. As aircraft are analyzed, one by one, for a certain time period, the intervals are not accumulated. Instead, the system keeps track of the shortest interval for all aircraft for each variate.

Table 8 below illustrates some exemplary field data for an aircraft with five SDRs.

TABLE 8

SDR Sequence	DOD	TYPE	Nature of Condition	Precautionary Procedure
1 <sup>st</sup>	May 01 1998	1	3	1
2 <sup>nd</sup>	May 03 1998	2	3	1
3 <sup>rd</sup>	May 07 1998	1	4	1
4 <sup>th</sup>	May 14 1998	3	4	1
5 <sup>th</sup>	May 25 1998	3	4	2

For the hypothetical aircraft data of Table 8 the data calculated for the univariates, for RPTX=2 and RPTY=15, is shown in Table 9 below.

TABLE 9

UNIVARIATE	SDR	AC	REPEAT	INTERVAL
TYPE 1	2	1	1	6
TYPE 2	1	1	0	0
TYPE 3	2	1	0	0
TYPE 4	0	0	0	0
NAT. COND. 1	0	0	0	0
NAT. COND. 2	0	0	0	0
NAT. COND. 3	2	1	1	2
NAT. COND. 4	3	1	1	7
PREC. PROC. 1	4	1	3	2
PREC. PROC. 2	1	1	0	0
PREC. PROC. 3	0	0	0	0

Data calculated for an exemplary bivariate, for RPTX=2 and RPTY=15, for the aircraft of Table 8 is shown in Table 10 below.

TABLE 10

BIVARIATE	SDR	AC	REPEAT	INTERVAL
PRE PROC 1 NAT COND 1	0	0	0	0
PRE PROC 1 NAT COND 2	0	0	0	0
PRE PROC 1 NAT COND 3	2	1	1	2
PRE PROC 1 NAT COND 4	2	1	1	7
PRE PROC 2 NAT COND 1	0	0	0	0
PRE PROC 2 NAT COND 2	0	0	0	0
PRE PROC 2 NAT COND 3	0	0	0	0
PRE PROC 2 NAT COND 4	1	1	0	0

Table 11 below shows which analysis modules use which aircraft-centric measurements (SDRs, ACs, repeats and intervals).

TABLE 11

ANALYSIS MODULE	SDR	AC	REPEAT	INTERVAL
310 - SURVEIL	Yes	Yes	Yes	Yes
320 - STANDARDIZATION	Yes	Yes	Yes	Yes
330 - TROHOC	Yes	Yes	Yes	Yes
340 - TABULATE	Yes	Yes	No	No
350 - ALF	No	No	No	No
360 - CLUSTER	Yes	Yes	Yes	Yes
370 - HILO	Yes	Yes	No	No
380 - RCO	No	No	No	No
390 - DILIGENCE	No	No	No	No
395 - COHORT	Yes	Yes	No	No

The analysis modules **310–395** will now be described. The SURVEIL module **310** produces and analyses time trends to compare events within a user-specified standard period (SP) and at least one user-specified comparison periods (CP). The standard period starts on a user specified calendar date and may be as long as the user wishes. The time element may be measured in days, weeks, months or years. All standard and comparison periods have the same length. The specified number of comparison periods can vary and, at one extreme, could cover the duration of the whole dataset from database **150** selected by the user via the user interface in selection filter **200**. As an example, five years of comparison periods could comprise 5 periods of 365 days, 20 periods of 91 days or 60 periods of 30 days (usually preceding the standard period).

A variate is defined to be exceptional if the aircraft-centric measurement for that variate is higher in the standard period compared to a user-defined minimum number of comparison periods. In other words, the variate's aircraft-centric measurement is "exceptionally high" (from the perspective of the standard period). An exceptional aircraft is considered to be an aircraft identified in the standard period and having any such exceptional variate. A variation of this exceptionality determination involves using the term "lower" instead of "higher" in the aforementioned description. In other words, for this variation the program searches for exceptionally low aircraft-centric measurements of variates (from the perspective of the standard period). The GUI interface of the analyses component **300** allows the user to toggle between these two exceptionality rules. The flow chart of FIG. **6a** shows the steps performed by the surveil module **310** to count univariate and bivariate fields and the flow chart of FIG. **6b** shows the steps performed to identify exceptional univariates and bivariates. With reference to FIGS. **6a** and **6b**, FIG. **6c** illustrates the manner by which moving averages are formed from comparison periods and FIG. **6d** illustrates the relationship between standard and

comparison fields. In FIGS. **6a–6c** a moving average is a user defined multiple (minimum of two) of consecutive comparison periods.

With respect to two adjacent comparison periods, a system default dictates that the earlier period finishes one day before the later period starts. The user may override this default via the GUI interface of the analyses component **300** so that the earlier period finishes exactly the same day the later period starts. In such latter case, however, the same SDR may be counted twice, in two different comparison periods, particularly if the SDR straddles the two periods. Another available option is to stagger the comparison periods so that there is an overlap between one comparison period and the next.

A comparison between variates is made as follows. A distribution, by either model or operator, of the foregoing univariate or bivariate tabulations is determined for output. Various statistical calculations are made on four aircraft-centric measurements (SDRs, Acs, repeats and intervals) for each variate. The SURVEIL module **310** also tabulates for output the activity history for aircraft and aircraft with reports in a standard period for variates not seen in any comparison period.

The STANDARDIZATION analysis module **320** standardizes SDR and aircraft data as between different operators, taking into account the differences in model mix and traffic pattern for each operator using an algorithm according to the following. For each time period the following steps are performed:

1. Normalizing data based on traffic patterns (e.g. miles, departures, aircraft hours, aircraft days or ramp to ramp hours) is tabulated in a 2-dimensional array (with subtotals for each column or row stored in appropriate array cells);
2. For each univariate/bivariate characteristic observed data (SDR, AC or REPEAT) is tabulated in a 2-dimensional array (operator by model) and subtotals for each column or row are stored in appropriate array cells;
3. For each operator and for each univariate, an aircraft-centric measurement is calculated as follows:
  - i) calculate ratio (R) of normalizing data for each model divided by normalizing data for all models; and,
  - ii) for each model, expected variate=R multiplied by the observed variate for all operators;
4. For each operator and for each variate characteristic the priority and statistical confidence limits are calculated as follows:
 
$$\text{priority} = \text{observed} - \text{expected}$$

$$\text{lower confidence} = (\text{multiplier} - \text{square root of observed})^2$$

$$\text{upper confidence} = (\text{multiplier} + \text{square root of observed})^2$$

$$\text{lower confidence limit} = \text{lower confidence} / \text{expected}$$

$$\text{upper confidence limit} = \text{upper confidence} / \text{expected}$$
 The multiplier is adjusted for multiple comparisons in accordance with the well-known Bonferonni method.
5. The foregoing calculations and results are output in tabular and/or graphical format.

FIGS. **7a**, **7b**, **7c** and **7d** are flow chart diagrams showing the steps performed by the STANDARDIZATION module **320** for standardizing variates for measurements of SDR, AC, repeats and intervals. The time period of interest used by this module is the same as the first time period of the selection filter component **200**. If desired, however, the illustrated algorithm could be modified to cover more time

periods (such as if, for example, the user is interested to perform a standardization over a longer period of time say two or more years). As shown by these flow charts module **320** performs a standardization process for standardizing all AC3 values (i.e. for all eleven major airlines) and all OTH values (i.e. models). If desired, these steps may be modified to standardize using a specific subset of ACs (as in standardizing using nine major airlines, not all eleven) and/or a specific subset of OTH. These flow charts show the steps of standardizing AC3 based on OTH data and this, also, may be modified if desired to standardize OTH based on AC3 data (in which case all references to AC3 and OTH in the flowchart would be replaced by OTH and AC3, respectively). The STANDARDIZATION module **320** can also be applied to normalize other data such as the age of an aircraft fleet.

The TROHOC module **330** compares the performance of various aircraft models and peer aircraft (defined as aircraft of the same model which were manufactured in the same time period). The name "trohoc" used by the inventors for this component is derived from the word "cohort" in that it is the reverse spelling of "cohort" and the reverse of the cohort process. A cohort is a group that is assembled together and followed forwards (into the future) over a period of time. For example, a cohort of patients can be followed through a course of treatment starting from the present and be monitored over time into the future. A trohoc, as referred to herein, is this cohort process performed in reverse. Specifically, the trohoc process provides that after a specified event, the previous histories of those objects which are affected by or involved with the event are compared with the previous histories of those objects which were not affected by or not involved with the same event.

The TROHOC module **330** compares SDR data between one aircraft and a group of peer aircraft and the comparison group are of the same model/version, age and operator, when numbers permit. For accident purposes, activity is considered for data from the earliest SDR for the accident aircraft until the date of the accident itself. The comparison group is selected on the basis of having SDRs before the earliest SDR for the accident aircraft and SDRs after the date of the accident. SDR reports are analysed for the same time period i.e. between the date of the earliest SDR for the accident aircraft and the date of the accident and, therefore, there is exactly the same time exposure for the accident aircraft and the comparison group.

As illustrated in FIGS. **8a** and **8b**, the TROHOC module **330** calculates rank and percentile values for each aircraft for each variate relative to all aircraft. An exceedance percentage value is selectable by the user, for example 75%, and this value identifies the number of variates for which each aircraft exceeds other aircraft. For an individual aircraft a determination is made of the number of variates above the selected exceedance value and the number of exceedances calculated for that aircraft are output for the user whereby the number of exceedances for a specific aircraft is provide for statistical comparison with an exceedance distribution calculated for the comparison group. Such comparisons can also be applied to non-accident situations (e.g. for a comparative assessment of one model with others or of an aircraft proposed for purchase with others).

Using the outputs of the SURVEIL and TROHOC modules **310**, **330** statistical norms are determined. The user specifies the level for which norms are desired. For example, the norm may be that achieved by 90% or less of aircraft or the norm may be that achieved by 99% of aircraft. The highest values found in the user-defined percentage of

aircraft are determined for each variate for specific aircraft models: (i) the number of SDR's per year; (ii) the mean time between occurrences; and, (iii) the number of repeat occurrences in a user-specified number of days (for example, 30 days). These norms are useful to provide benchmarks for identifying 'exceptional' aircraft.

The TABULATE module **340** is provided to enable any operator (whether US or foreign) to apply U.S. statistical norms to identify exceptional aircraft in its own fleet of aircraft. This module provides authoritative data for assessing the mechanical reliability of an operator's fleet and provides confidentiality in that a foreign operator may utilize this module without having to divulge its own data on occurrences of mechanical problems, defects or malfunctions affecting safety. As illustrated by FIG. **9** the steps performed by this module include the following:

1. Input data is received from the user (through the GUI), namely, the number and type of models in the user/operator's fleet and the level of statistical rarity sought.
2. The Service Difficulty Reports for the same models are analysed.
3. A data file is generated from the analysis for that user/operator.
4. Further input data is received from the user/operator in the form of a filled-in table for each of the variates in which they have interest.
5. The values expected for each variate are calculated from the US statistical norms (as identified above the values are the number of SDR's per year, the mean time between occurrences and the number of repeat occurrences in a user-specified number of days such as 30 days).

The ALF module **350** identifies related SDRs on the basis of user-specified criteria including kind, nature of condition, precautionary procedure, severity, stage of operation, the time between DOD and DOR, year built, ATA 2 CHAR, ATA 4 CHAR and a key word search. SDRs meeting the user-specified criteria are classified as related SDRs while those that do not are considered to be unrelated. An episode is defined by the module to be a collection of related SDRs for which each pair of subsequent related SDRs are a given number ("x") of days apart or less (and the "x day" period is referred to as a demarcation period). The length of a demarcation period is measured by user selected time units (TU's) by days, weeks, months, quarters and/or years. The demarcation periods (also referred to herein as windows) have various starting and ending points and hence various lengths. All windows are user definable and can have "a" number of time units (TU) in days, weeks, months, quarters or years, "b" number of SDRs, "c" number of related SDRs (i.e. excluding unrelated SDRs), "d" number of unrelated SDRs (i.e. excluding related SDRs), "e" number of episodes up to and including the day immediately before the xth episode starts, "f" number of episodes up to and including the day the xth episode starts, "g" number of episodes up to and including the day the xth episode ends. Further, a window can start or finish at the following points (for any of the foregoing lengths): an arbitrary date, nth SDR, m TU before/after nth SDR, nth last SDR, m TU before/after nth last SDR, nth SDR before/after an arbitrary date, m TU before/after nth SDR before/after an arbitrary date, mth SDR of the nth episode, mth SDR of the nth episode before/after an arbitrary date, mth SDR of the nth episode before/after an arbitrary date, k TU before/after mth SDR of the nth episode, k TU before/after mth SDR of the nth episode before/after an arbitrary date, whereby the values of the dates, k, m, n and x are user-definable and selectable.

As illustrated by FIG. **10(a)** the ALF module **350** performs analyses on the basis of SDRs, ACs, episodes and



windows. FIGS. 10(b) and 10(c) display a descriptive listing of sample output produced by the ALF module.

The CLUSTER module 360 identifies a statistically unusually high number of mechanical problems and/or incidents within relatively short periods of time, the length of which is user defined and specified, the steps performed by this cluster being illustrated by FIGS. 11a and 11b. A cluster is defined to be a number of SDRs (minimum of one) with the same variate where each SDR is no more than a user selectable number of days away from its subsequent SDR. For example, if each cluster is defined to be three days long, the aircraft covered by Table 12 below would have the clusters shown in Table 13 below. For the data of this example, the module determines and outputs "May 05-07, 1998" as the aircraft's cluster since this particular cluster contains three SDRs and three is more than any other cluster. Similarly, the module determines and outputs for each uni/bivariate the cluster having the highest number.

TABLE 12

SDR Sequence	SDR DOD
1 <sup>st</sup>	May 01, 1998
2 <sup>nd</sup>	May 02, 1998
3 <sup>rd</sup>	May 05, 1998
4 <sup>th</sup>	May 06, 1998
5 <sup>th</sup>	May 07, 1998

TABLE 13

Cluster (each 3 days long)	Number of SDRs
May 01-03, 1998	2
May 02-04, 1998	1
May 03-05, 1998	1
May 04-06, 1998	2
May 05-07, 1998	3
May 06-08, 1998	2
May 07-09, 1998	1
May 08-10, 1998	0

The HILO module 370 determines from all aircraft in the intermediary file 250 the high and low numbers of SDRs over relatively long periods of time, and the steps performed by this module are illustrated by FIG. 12.

The National Transportation Safety Board (NTSB) investigations of accidents and major incidents result in recommendations. A cumulative database of NTSB recommendations to the FAA since 1963 is available to the public and this database includes the date of the occurrence, the date and identifying number of the recommendation, the date and content of the FAA responses, the NTSB assessments of the response as acceptable or unacceptable and whether the NTSB considers the issue open or closed. This database covers all recommendations and their status at successive periods (i.e. 1, 2 and 5 years). The RCO module 380 analyses this data and outputs, in a standardized format, the time trends relating to the numbers of recommendations and also the status of the recommendations (either open or closed and satisfactory or unsatisfactory). This module also systematically compares short term and long term results. FIG. 13 is a flow chart illustration of steps performed by the RCO module 380.

Operators vary in the extent and nature of the problems they report and this is referred to herein as being variability in the diligence of reporting. The DILIGENCE module 390 systematically quantifies the diligence of operators. The following is a description of the operation of this module:

- The source data used by this module is a TROHOC output file (i.e. produced by the TROHOC module 320) which summarizes the reports for each aircraft.
  - The module considers six variables for each aircraft which reflect the operator's level of carefulness and regularity in preparing SDR's:
    - PEMULT—the extent of multiple responses. The report form has 4 fields for Precautionary Procedures and 3 fields for Nature of Condition. More diligent operators will tend to complete more than one field.
    - SEVOCCUR—the proportion of more severe occurrences. More diligent operators will tend to submit not only more severe occurrences but less severe occurrences. There are two components:
      - Ratio of unscheduled landings to all precautionary procedures.
      - Ratio of more severe part defects (detailed in the "Severity" variable) to all part defects.
    - CDBIGNO—the intensity of reporting maintenance checks. The "D check" is a major check every three-and-a-half years during which aircraft are essentially taken apart and put back together with many components replaced. This value is determined from the largest number of inspection/maintenance reports submitted in any 60-day period.
    - SDRLONGINT—The longest interval between the dates of two consecutive SDR's.
    - DAYSTOEND—The number of days between the date of the latest SDR submitted and the end of the period analyzed.
    - PROPAC—The proportion of all aircraft for which any SDR is submitted.
  - The statistical distributions for each of these variables are calculated and cut-off points are determined from the tails of the distributions. Scores, based on these cut-off points, are assigned to each of the 6 variables for each aircraft.
  - The scores for each aircraft are summed.
  - The distribution of scores for all aircraft for a specific operator is calculated.
  - The score distributions (median and variance) are used to calculate rankings for each of the operators (i.e. the ranks being low, medium and high diligence).
- FIG. 14 is a flow chart illustration of steps performed by the DILIGENCE module 390.
- The COHORT analysis module 395 counts the number of occurrences in successive time periods for equipment grouped by construction number. This module is used to address the fact that production line problems may affect equipment assembled during the same time period. These problems may be due to either labor unrest or short-term problems in component manufacture or quality control. More specifically, equipment assembled during one time period may be less reliable than equipment assembled in previous or subsequent time periods. Equipment failure may occur at various follow-up intervals, months, years or even decades in the future but the failure may not be directly identified as a cause of a problem since the original defect may contribute relatively early to a multi-factorial causal chain.
- Analyses must focus on equipment categorized by their chronological dates on the production line specified by the year delivered or by their construction number. The COHORT analysis module 395 groups aircraft by construction number and examines the number of safety-related occurrences in subsequent time periods. The analysis can be world-wide for accidents (whether total hull-loss or substantial damage). U.S. data can be used for Incidents and for

Service Difficulty Reports. The purpose of this module is to detect sub-groups with significantly higher rates of safety-related occurrences in comparison to earlier or later sub-groups. The rates are calculated on the basis of the number of aircraft in active use. Aircraft withdrawn from use are withdrawn from the denominator.

The following steps are performed by the COHORT module **395**:

7. Select subgroup: Model version.
8. Group by construction number.
9. Calculate number of aircraft in active use at start of each time period for as many follow-up years as desired by the user.
10. Tabulate number of safety related occurrences in each follow-up period.
11. Calculate ratio of safety related occurrences per number exposed.
12. Determine statistical significance of differences between adjacent construction number groups.

The graphizer component **400** provides the calculated data to the user in tabular, text and/or graphic display form (the latter being produced by condensing large data tables into graphs). A multi-result inter-related graphic display is provided by this component as illustrated in FIG. **16(c)**, in which three separate graphs are shown on a single screen (this number of graphs being suitable for notebook computer screen sizes, but a larger number of graphs could be accommodated by larger screen sizes). The graphizer component provides to the user, within this graphic display, a menu of datasets for selection of a desired dataset (see window **410** which provides a choice of ATA, Precautionary Procedure and Nature of Condition datasets). Corresponding to the selected dataset **410**, a further menu of data subsets **420** is provided to the user for selection of a data subset (the selected subset shown being Unscheduled Landing).

The graphizer component generates a graphical presentation (being the main graph) **430** of the global output data set produced by the analyses component **300** for the selected data set and subset. From that main graph **430** the graphizer component receives from the user, by highlighting (i.e. a point and click means of selection), a selection of one or more related data subsets **440** and, in response, generates additional graphical presentations **450, 460** for each such data subset. As shown by FIG. **16(c)** the additional graphical presentation(s) are displayed together on the same screen display. In preparing the main graph **430** and subgraph(s) **450, 460** for display the graphizer component formats each graphical presentation to an appropriate size and position for collective viewing. As illustrated by FIG. **16(c)**, the main graph **430** shows the ranking of each selectable subgraph data set (e.g. by operator) and the subgraph(s) shows greater detail for specific elements of the selected data subset (i.e. in this illustration, for the selected operator BB).

For the illustrated embodiment, an initial screen is provided to the user which permits the user to select criteria from a number of menus including menus covering Operator/Model (e.g. 11 major operators or 15 models), Focus (e.g. Service Difficulty Reports, Accidents/incidents and Engine reliability), ATA (mechanical component), Precautionary procedure (e.g. unscheduled landing), Nature of condition (e.g. smoke) and Stage of Operation (e.g. take-off). FIG. **16(a)** shows an output graph generated by the graphizer **400** for a selection by the user of the ATA menu item "Flight Control Sys (A2)", this graph representing data for the "flight control sys" reports by the eleven (11) operators identified within each operator bar (e.g. the second bar from the top representing operator "BB"). In this graph

the percentages shown represent the number of smoke reports for each of the 11 operators, normalized by model and number of departures, with the group average being 100%. The two-graph display of FIG. **16(b)** shows time trends for SDRs and the number of repeat occurrences, wherein the highlighted circle shows the ratio of the latest number to the two previous high numbers (and the two previous high numbers are shown by large dots).

The foregoing description of the preferred embodiment describes aircraft-centric measurements of the present information system and method because the illustrated embodiment relates to the field of analyzing aviation safety data. However, these measurements and analyses can be equally applied to other fields such as health and product safety. For example, a patient may be the object and records of doctors' reports (i.e. from patient visits to doctors or hospitalizations), rather than SDRs, might then form the basis on which analyses are conducted. In the health field, there are multiple sources of data which, without the benefit of the present system and method, are not readily collated to follow the longitudinal side effects, course and outcomes of various medical treatments. The present system and method can thereby provide the surveillance and monitoring means which is needed to detect epidemics or other undesirable outcomes and to identify risk factors.

The terms algorithm, function, module and component herein are interchangeable and are used generally herein to refer to any set of computer-readable instructions or commands such as in the form of software, without limitation to any specific location or means of operation of the same, and without limitation as to the format, style, organization or size of the command sets to be selected for any particular embodiment.

It is to be understood that the specific elements of the information system and method described herein are not intended to limit the invention defined by the appended claims. From the teachings provided herein the invention could be implemented and embodied in any number of alternative computer program embodiments by persons skilled in the art without departing from the claimed invention.

## APPENDIX A

### DEFINITIONS AND EXPLANATIONS OF TERMS USED IN THE DESCRIPTION HEREIN AND IN THE SYSTEM'S DATA SOURCES

**Accident** An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and until such time as all persons have disembarked, and in which any person suffers death or serious injury or in which the aircraft receives substantial damage. Substantial damage means damage or failure which adversely affects the structural strength, performance or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component. Engine failure or damage limited to the engine if only one engine fails or is damaged, bent failings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes or wingtips are not generally considered "substantial damage".

**Accident Rates** Accident counts alone are not reliable indicators of the relative safety of airlines/operators, aircraft types, or segments of the air transportation industry because, all other things being equal, an airline with 500 airplanes

will probably have more accidents than an airline with 10 airplanes. Similarly, the more frequently used aircraft types would tend to be involved in accidents more than the less frequently used types. The method most commonly used to address these issues is to calculate accident rates in terms of accident counts divided by some measure of aviation activity; i.e., accident counts divided by flight hours, departures, miles, etc.

**ASRS (Aviation Safety Report System)** A voluntary, confidential and anonymous incident reporting system used to identify hazards and safety discrepancies in the National Airspace System. It is also used to formulate policy and to strengthen the foundation of aviation human factors safety research. It was started in 1976 as a means for the FAA to obtain reports of deficiencies and discrepancies before accidents or incidents occur. Pilots, air traffic controllers, flight attendants, mechanics, ground personnel, and others involved in aviation operations can submit reports to the ASRS when they are involved in, or observe, an incident or situation in which they believe aviation safety was compromised. The FAA provides limited immunity from regulatory enforcement action to reporters as an incentive to report incidents. The ASRS identifies the airport and, since January 1994, the aircraft model, but not the registration, serial number or airline. The program encourages submissions by granting those who file reports anonymity and limited immunity. The ASRS database contains reports submitted from 1988 to present.

**ATA** Refers to the Air Transport Association Joint Aviation Statistical code (statistical classification) indicating the mechanical component where the difficulty on the aircraft occurred. Also referred to as JASC—Joint Aviation Statistical Code.

**ATC** Refers to air traffic control.

**BTS** Bureau of Transportation Statistics (USA).

**Category of Operation** Aviation operators are categorized by the federal regulation that govern their conduct. The major categories in the NTSB database are:

Air Carriers (Scheduled Part 121 and Part 127 operators)

Charter Air Carriers (Non-scheduled Part 121 operators)

Commuter Airlines (Scheduled Part 135 operators)

Air Taxis (Non-scheduled Part 135 operators)

**Departures** The number of aircraft take-offs actually performed in domestic and international scheduled and non-scheduled passenger/cargo and all-cargo revenue services.

**Enforcement Action** The FM publishes a quarterly compilation of enforcement actions against regulated aviation entities that are closed with a civil penalty or issuance of a certificate for suspension or revocation. At the end of each quarter of the calendar year, the FAA compiles a data run for all enforcement actions against aviation entities that involve safety and security issues and result in a civil penalty or issuance of a suspension or revocation order. Some security cases may be reported in the quarter following the quarter in which the action was closed. For purposes of this report, cases are considered to be closed after an order has issued that is no longer appealable or when a civil penalty is imposed. However, for other record-keeping purposes in the Enforcement Information System a case is considered closed only after some other event occurs, e.g., payment of a civil penalty or a determination that the penalty is not collectable or, in the case of suspension or revocation, surrender of the certificate.

**Engine Utilization/Reliability** The air carrier aircraft and engine utilization report covers engine shutdowns and removals identified by air carrier, aircraft model and engine model.

**FAA Airworthiness Directives** The FM issues alerts about unsafe conditions that are newly discovered. These directives specify the date by which implementation of corrective action is required.

**FAA Incident Data System** The FM Incident Data System contains incident data records for all categories of civil aviation. Incidents are events that do not meet the aircraft damage or personal injury thresholds contained in the NTSB definition of an accident. For example, the database contains reports of collisions between aircraft and birds while on approach to or departure from an airport. While such a collision may not have resulted in sufficient aircraft damage to reach the damage threshold of an NTSB accident, the fact that the collision occurred is valuable safety information that may be used in the establishment of aircraft design standards or in programs to deter birds from nesting in areas adjacent to airports. The FAA Incident Data System contains events that occurred between 1978 and the present.

**Fatal injury** Any injury which results in death within 30 days of the accident.

**GAO** General Accounting Office

**Hours Flown** The airborne hours in domestic and international scheduled and non-scheduled revenue service, computed from the moment an aircraft leaves the ground until it touches the ground again.

**Incident A** potentially hazardous event which, although not meeting the aircraft-damage or personal-injury thresholds for an accident (as defined by the NTSB), is associated with the operation of an aircraft and affects or could affect the safety of operations.

**JASC** See ATA

**Longitudinal Analysis** By following up individual objects (in this example, individual aircraft).

**Miles Flown** The miles (computed in airport-to-airport distances) for each inter-airport trip actually completed in domestic and international revenue services, scheduled and non-scheduled. In cases where the inter-airport distances are inapplicable, aircraft miles flown are determined by multiplying the normal cruising speed for the aircraft type by the airborne hours.

**Model Mix** Refers to the factor that no two airlines fly identical aircraft fleets on identical routes. Some tend to fly larger aircraft on long routes while others fly smaller aircraft more frequently on shorter routes.

**NASDAC (National Aviation Safety Data Analysis Center)** The Federal Aviation Administration (FAA) promotes the open exchange of safety information in order to continuously improve aviation safety. To further this basic objective, the FAA has established the National Aviation Safety Data Analysis Center (NASDAC). It is expected that, eventually, this facility will be made available for use throughout the aviation safety community. The center is currently located in the headquarters building of the United States Federal Aviation Administration. NASDAC works towards simplifying and automating aviation data analysis processes and expands access to data and information.

**Nature of Condition** Symptoms or problems identified from a Service Difficulty Report and identified by 24 values e.g. warning indicator, fluid loss, etc.

**Near Mid-Air Collision (NMAC)** An NMAC is an incident associated with the operation of an aircraft in which a possibility of a collision occurs as a result of proximity of less than 500 feet to another aircraft or a report from a pilot or flight crew member stating that a collision hazard existed between two or more aircraft. The NMAC reporting system was revised substantially in 1992.

**NTSB** The National Transportation Safety Board (NTSB) is a United States independent federal agency charged by

Congress with investigating every civil aviation accident in the United States. The NTSB determines the probable cause of accidents, and issues safety recommendations aimed at preventing future accidents. The NTSB accident/incident database contains investigation reports from 1983 to present.

NTSB Safety Recommendations to the FAA With FAA Responses The NTSB makes safety recommendations to all elements of the transportation industry. Recipients of a recommendation have to respond formally to the recommendation and specify what action is or is not being taken and why. There is an NTSB database which contains the aviation safety recommendations, the FAA responses, the subsequent correspondence and NTSB's appraisal of the response. NTSB uses the information it gathers during accident investigations and the determination of probable cause to make safety recommendations to all elements of the transportation industry. While the recipient of a recommendation does not have to implement the proposed action, it does have to formally respond to the recommendation and specify what action is or is not being taken and why. This database contains NTSB's recommendations to the FAA and the FAA's responses. It is an historical record of correspondence between the NTSB and the FAA. The NTSB Safety Recommendations database includes recommendations that were written between 1963 and the present.

Occurrence An event, other than an accident, that affects or could affect the safety of aviation operations and that is investigated by the FAA.

OMEC The Operator/Model Exposure and Costs dataset (used by the standardization analysis module 320).

Operational Deviation (OD) An occurrence where applicable separation minima, as referenced in the operational error (OE) definition below were maintained, but:

- (1) less than the applicable separation minima existed between an aircraft and protected airspace without prior approval,
- (2) an aircraft penetrated airspace that was delegated to another position of operation or another facility without prior coordination and approval,
- (3) an aircraft penetrated airspace that was delegated to another position of operation of another facility at an altitude or route contrary to the altitude or route requested and approved in direct coordination or as specified in a Letter of Agreement, pre-coordination or internal procedure,
- (4) an aircraft, vehicle, equipment, or personnel encroached upon a landing area that was delegated to another position of operation without prior coordination and approval.

Operational Error (OE) An occurrence attributable to an element of the air traffic control system which results in less than the applicable separation minima between two or more aircraft, or between an aircraft and terrain or obstacles as required by Handbook 7110.65 and supplemental instructions. Obstacles include vehicles/equipment/personnel on runways, or aircraft lands or departs on a runway closed to aircraft operations after receiving air traffic authorization.

Operator The individual, firm, or airline that causes the aircraft to be scheduled, moved or dispatched.

Pilot Deviation (PD) The actions of a pilot which result in the violation of a Federal Aviation Regulation (FAR) or a North American Aerospace Defense Command (NORAD) Air Defense Identification Zone (ADIZ) tolerance.

Precautionary Procedure Responds to the urgent condition where there is a concern about the safety of the aircraft or people on board. A precautionary procedure differs from normal procedures, but is less than an emergency or distress

procedure which requires immediate assistance due to serious and/or imminent danger. Identified by 15 values eg. unscheduled landing, engine shutdown, etc.

Production Lists These detail aircraft characteristics (serial number, construction number, year built, engines), their operators and current status (in service, stored, written off or scrapped) and are provided in print and electronic form.

RCO Recommendation course and outcomes.

Registration Number An aircraft must be registered to be flown legally in the U.S. The FAA assigns a unique identification number to each registered aircraft called a registration number (commonly referred to as the "N Number" since all U.S. registration numbers start with "N"). The registration number is unique only among the population of currently registered aircraft and may be reused if an aircraft is destroyed or, for other reasons, its registration is allowed to lapse.

Remarks (SDR) Descriptive data provided in a Service Difficulty Report describing the conditions subsequent to or leading up to a reported problem, and may identify the cause for a malfunction and/or the emergency measures executed.

Runway Incursion Any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in loss of separation with an aircraft taking off, intending to take off, landing or intending to land.

Separation Minima The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of air traffic control procedures.

Serious Injury Any injury which:

1. requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received;
2. results in a fracture of any bone (except simple fractures of fingers, toes or nose);
3. causes severe hemorrhages, nerve, muscle or tendon damage;
4. involves any internal organ or;
5. involves second or third degree burns or any burns affecting more than 5 percent of the body surface.

Service Difficulty Report (SDR) Passenger aircraft of ten seats or more must report the occurrence or detection of each failure, malfunction or defect concerning specified events or anything else that has endangered or may endanger safe operations. The Flight Standards Service Difficulty Program objective is to achieve prompt and appropriate correction of conditions adversely affecting continued airworthiness of aeronautical products, through the collection of Service Difficulty and Malfunction or Defect Reports. The FAA's Service Difficulty Reporting program originated in the early 1970's with the earliest records currently available dating June, 1974.

Severity Identified by 7 values e.g. seldom, uncommon, frequent.

Stage of Operation Used to identify the operation state (i.e. when) and has 18 values e.g. approach, climb, cruise, descent, etc.

Traffic Refers to the Bureau of Transportation Statistics—Airline Traffic Statistics. The airline activity spreadsheet available on the Aviation Safety Information Web site contains, by airline, the number of departures, flight hours and miles performed in domestic and international, commercial service during the most recent five calendar years. These are the activity measures that are used most frequently by government and industry to calculate accident or incident rates for the principal segments of the air transportation system.

Traffic Denominators Factors which take into account the fact that more accidents occur during takeoff and landing than during other phases of flight and, therefore, the selection of the measure of aviation activity that is used to calculate rates will bias the results. For example, an airline that flies longer routes has fewer takeoffs and landings per hour and is thus favored by use of hours as the measure of activity, while an airline that flies shorter routes is favored by the use of departures as the measure of activity.

Traffic Exposure Refers to days of operation, departures, hours of aircraft flight, hours (gate to gate), and miles.

Turbojet Aircraft An aircraft having a jet engine in which the energy of the jet operates a turbine which in turn operates the air compressor.

Turboprop Aircraft An aircraft having a jet engine in which the energy of the jet operates a turbine which drives the propeller.

Type A hierarchical classification of four values, namely, UEL, major, routine, NMNR (not major, not routine), which may also be referred to as "kind".

Unsafe or illegal Action/Condition During an Event Indicates whether the primary problem is with the aircraft, flight crew, ATC, airport, navigational aids, publications or weather.

Unscheduled Landing Types

Passenger precipitated (illness, premature labor or disruptive behavior)

Diversions due to weather

Known or suspected mechanical difficulties or malfunctions (SDR's)

Vehicle/Pedestrian Deviation (VPD) An entry or movement on an airport movement area by a vehicle operator or pedestrian that has not been authorized by air traffic control (includes aircraft operated by a non-pilot).

## APPENDIX B

### VALUES OF THE FIELDS OF SERVICE DIFFICULTY REPORTS (SDRS):

TYPE (4 values)

UEL (Unscheduled Emergency Landing)

MAJOR

ROUTINE

NMNR (Not major, not routine)

NATURE OF CONDITION (23 values)

VISIBLE FLAME

SMOKE

FOREIGN OBJECT

INFLIGHT SEPARATION

VIBRATION

CONTROLS AFFECTED

MULTIPLE FAILURES

POWER SOURCE LOSS

FLIGHT ALTITUDE INDICATOR

WARNING INDICATION

FLUID LOSS

SYSTEM TEST BAD

OVERTEMP

FALSE WARNING

OTHER

NO WARNING INDICATION

ENGINE POWER LOSS

OTHER SYSTEM AFFECTED

CASE PENETRATION

INADEQUATE QUALITY

FLAMEOUT

STOPPAGE

SIGNIFICANT FAILURE

PRECAUTIONARY PROCEDURE (14 values)

UNSCHEDULED LANDING

EMERGENCY DESCENT

ABORT TAKEOFF

RETURN TO BLOCK

ENGINE SHUTDOWN

FIRE EXTINGUISHER

OXYGEN MASK

DEACTIVATE SYSTEM

DEPRESSURIZATION

DUMP FUEL

INONE

ABORT APPROACH

OTHER

AUTOROTATION

SEVERITY (6 values)

SELDOM

UNCOMMON

OCCASSIONAL

COMMON

FREQUENT

OVER 24 MO

STAGE OF OPERATION (17 values)

AIR AMBULANCE

AEROBATIC

AGRICULTURE

APPROACH

CLIMB

CRUISE

DESCENT

EXTERNAL LOAD

FIRE FIGHTING

HOVERING

INSPECTION/MAINTENANCE

LANDING

MAPPING/SURVEY

NOT REPORTED

TAKEOFF

TAXI

UNKNOWN

YEAR BUILT (5 values)

1900-1901 YEAR BUILT

1902-1968 YEAR BUILT

1969-1978 YEAR BUILT

1979-1988 YEAR BUILT

1989-1999 YEAR BUILT

DOD-DOR (7 values)

DOR-DOD

0 DOR-DOD

1-3 DOR-DOD

4-11 DOR-DOD

12-26 DOR-DOD

27-55 DOR-DOD  
 56-112 DOR-DOD  
 113+DOR-DOD  
 PARETO (18 values)  
 0 SDRS  
 1 SDRS  
 2 SDRS  
 3 SDRS  
 4 SDRS  
 5 SDRS  
 6 SDRS  
 7 SDRS  
 8 SDRS  
 9 SDRS  
 10 SDRS  
 11-14 SDRS  
 15-24 SDRS  
 25+SDRS  
 4+SDRS  
 3+SDRS  
 2+SDRS  
 1+SDRS  
 MODEL (112 values)  
 BOEING 107  
 BOEING 234  
 BOEING 707  
 BOEING 720  
 BOEING 727  
 BOEING 737  
 BOEING 747  
 BOEING 757  
 BOEING 767  
 BOEING 777  
 DOUGLAS C118  
 DOUGLAS DC3  
 DOUGLAS C54 (DC4)  
 DOUGLAS DC6  
 DOUGLAS DC7  
 DOUGLAS DC8  
 DOUGLAS DC9  
 DOUGLAS MD88 (DC9)  
 DOUGLAS DC10  
 DOUGLAS MD11 (DC11)  
 DOUGLAS MD90  
 AIRBUS 300  
 AIRBUS 310  
 AIRBUS 320  
 AIRBUS 330  
 AIRBUS 340  
 LOCKHEED 1011 TRISTAR  
 LOCKHEED 132  
 LOCKHEED 188  
 LOCKHEED 382  
 DEHAVILLAND DHC2  
 DEHAVILLAND DHC3  
 DEHAVILLAND DHC6  
 DEHAVILLAND DHC7

DEHAVILLAND DHC8  
 AEROSPATIALE AS262  
 AEROSPATIALE AS355  
 AEROSPATIALE AS365  
 5 AEROSPATIALE ATR42  
 AEROSPATIALE ATR72  
 AEROSPATIALE CONCORDE  
 BAE ONE-ELEVEN  
 10 BAG BAE146  
 BAE HP137  
 BAG JETSTM  
 BAE ATP  
 15 BOLKMS BK117  
 BOLKMS BO105  
 EMBRAER 110  
 EMBRAER 120  
 20 FOKKER F27 FRIENDSHIP  
 FOKKER F28 FELLOWSHIP  
 SAAB SF340  
 SHORTS (STBROS) SD3  
 25 SWEARINGEN SA226  
 SWEARINGEN SA227  
 AMD DASSAULT FALCON  
 BEECH 1900  
 30 BEECH C45  
 BEECH 58  
 BEECH 99  
 BEECH 100  
 35 BEECH 200  
 CASA C212  
 CANADAIR CL600  
 CANADAIR CL44  
 CURTISS C46  
 40 CONVAIR 240  
 CONVAIR 340  
 CONVAIR 440  
 CONVAIR APJC  
 45 DORNIER 228  
 DORNIER 328  
 FAIRCHILD FH27  
 FAIRCHILD FH227/SA227  
 50 NIHON YS11  
 AGUSTA A109  
 BNORM BN2A  
 BRAERO BAE125  
 55 BRAERO HS748  
 CESSNA 172  
 CESSNA 207  
 CESSNA 208  
 60 CESSNA 402  
 CESSNA 404  
 CESSNA 550  
 HUGHES 369  
 65 HWKSLY DH114  
 LEAR 24  
 LEAR 25

LEAR 35  
 MARTIN 404  
 MTSBSI MU2B  
 PIPER PA232  
 PIPER PA313  
 PIPER PA31  
 SNIAS AS350  
 WESTLD WESTLAND  
 SKRSKY S76 COPTER  
 BELL 205 COPTER  
 BELL 206 COPTER  
 BELL 212 COPTER  
 BELL 214 COPTER  
 BELL 222 COPTER  
 BELL 230 COPTER  
 BELL 407 COPTER  
 BELL 412 COPTER  
 GULFSTREAM G1159  
 GULFSTREAM G159  
 AIRBUS 319  
 EMBRAER 145  
 DEFAULT  
 BTS MODEL (118 values)  
 DHAV DHC2  
 DHAV DHC3  
 DHAV DHC4  
 DOUG DC2 (EXPECT NONE)  
 DOUG DC3 & C47  
 DOUG DC4 & C54  
 DOUG DC6 DEFAULT  
 DOUG DC6A  
 DOUG DC6B  
 DOUG DC7B  
 DOUG DC7C  
 LKHEED1049 DEFAULT  
 LKHEED1049H  
 DHAV DHC81  
 DHAV DHC83  
 DHAV DHC6  
 LKHEED188  
 LKHEED382  
 DHAV DHC7  
 BOEING7375XX  
 BOEING7374XX  
 BOEING7373XX W/LR (EXPECT NONE)  
 BOEING7373XX W/O LR  
 BOEING7372XX W/O C & 1XX  
 BOEING7372XX W/C  
 BOEING7572XX  
 BOEING7672XX  
 BOEING7673XX  
 BOEING777  
 DOUG DC91 DEFAULT  
 DOUG DC915F  
 DOUG DC93  
 DOUG DC94  
 DOUG DC95

DOUG DC987  
 DOUG DC98 DEFAULT & MD88  
 DOUG MD9  
 5 AIRBUSA300B4 & 300F  
 AIRBUSA3102  
 AIRBUSA3103  
 AIRBUSA3202  
 AIRBUSA300B2  
 10 AIRBUSA330 (EXPECT NONE)  
 BOEING7271XX W/O C  
 BOEING7271XXW/C  
 BOEING7272XX  
 15 DOUG DC101  
 DOUG DC102 (EXPECT NONE)  
 DOUG DC103 W/O CF  
 DOUG DC104  
 20 DOUG DC103 W/CF (EXPECT NONE)  
 DOUG MD11  
 BOEING7071XX W/O B  
 BOEING7071XX W/B  
 25 BOEING7072XX (EXPECT NONE)  
 BOEING7073XX W/O B W/O C  
 BOEING7073XX W/B  
 BOEING7073XX W/C  
 30 BOEING7074XX  
 BOEING7200 W/O B  
 BOEING7200 W/B  
 BOEING7471XX  
 35 BOEING7472XX & 3XX  
 BOEING747 W/C  
 BOEING7474XX  
 BOEING747 W/F  
 40 BOEING747 W/SP  
 DOUG DC81 (EXPECT NONE)  
 DOUG DC82  
 DOUG DC83  
 DOUG DC84  
 45 DOUG DC85  
 DOUG DC8F5  
 DOUG DC861  
 DOUG DC863F  
 50 DOUG DC862  
 DOUG DC863 DEFAULT  
 DOUG DC871  
 DOUG DC872  
 55 DOUG DC873 DEFAULT  
 DOUG DC873F  
 AIRBUSA340  
 BOEING107 & 114  
 60 BOEING234  
 BOEING7070XX  
 BOEING707 DEFAULT  
 BOEING720 DEFAULT  
 BOEING7270XX  
 65 BOEING727 DEFAULT  
 BOEING7370XX

BOEING737 DEFAULT  
 BOEING7470XX  
 BOEING747 DEFAULT  
 BOEING7570XX  
 BOEING757 DEFAULT  
 BOEING7670XX  
 BOEING767 DEFAULT  
 BOEING DEFAULT  
 AIRBUSA300 DEFAULT  
 AIRBUSA310 DEFAULT  
 AAIRBUSA319  
 AIRBUSA320 DEFAULT  
 AIRBUS DEFAULT (EXPECT NONE)  
 DHAV DHC1  
 DHAV DHC82  
 DHAV DHC8 DEFAULT  
 DHAV DEFAULT  
 DOUG DC7 DEFAULT  
 DOUG DC8 DEFAULT  
 DOUG DC92  
 DOUG DC9 DEFAULT  
 DOUG DC10 DEFAULT"  
 DOUG DEFAULT"  
 LKHEED10113  
 LKHEED1011 DEFAULT  
 LKHEED132  
 LKHEED DEFAULT  
 UNDEF MANUFACTURER  
 OPERATOR CODE (225 values)  
 AALA AMERICAN  
 UALA UNITED  
 DALA DELTA  
 USAA USAIR  
 NWAA NORTHWEST  
 CALA CONTINENTAL  
 FDEA FEDERAL EXPRESS  
 TWAA TRANS WORLD  
 SWAA SOUTHWEST  
 AWXA AMERICA WEST  
 IPXA UPS  
 COMA COMAIR  
 ASAA ALASKA  
 HZMA HORIZON  
 AMTA AMERICAN TRANS  
 EIAA EVERGREEN INT  
 SRAA SOUTHERN AIR TRANSPORT  
 HALA HAWAIIAN  
 MWEA MIDWEST EXPRESS  
 TSAA ALOHA  
 TWRA TOWER  
 MRKA MARKAIR  
 TAOA USAIR SHUTTLE"  
 WRLA WORLD AW  
 RIVA CARNIVAL AL  
 CLCA CHALLENGE AC  
 DHLA DHL AW  
 RRXA EMERY WORLDWIDE AL

IXKA KIWI INT  
 ORJA RENO  
 VJ6A VALUJET (NOW AIRTRAN)  
 5 MZZA CONTINENTAL MICRONESIA  
 EALA EASTERN  
 HEEA PETROLEUM HELICOPTER  
 ZZDA AIRTRAN (WAS VALUJET)  
 GTIA SPIRIT  
 10 W8PA OKLAHOMA MAY 99  
 P2EA VANGUARD  
 AAA ALLEGHENY  
 KT3R OKLAHOMA MAY 99  
 15 AWI HUGHES AIR WEST  
 F3LA FRONTIER  
 VFSA OKLAHOMA MAY 99  
 NCA NORTH CENTRAL  
 20 GUUA GULFSTREAM INT  
 K3HA KIWI INT  
 SABA OKLAHOMA MAY 99  
 TC8A TRANS CONTINENTAL  
 25 H3R OKLAHOMA MAY 99  
 PNSA PENINSULA  
 EQGA OKLAHOMA MAY 99  
 SOU SOUTHERN AW  
 30 WAA WIEN AIR ALASKA  
 BDHA OKLAHOMA MAY 99  
 FXLA FINE  
 APN OKLAHOMA  
 35 BJNA TEM ENTERPRISES  
 PAIA PIEDMONT AL  
 PAAA PAN AMERICAN WORLD  
 FALA FRONTIER AL  
 BNFA BRANIFF AW  
 40 TXIA TEXAS INT AL  
 OZAA OZARK AL  
 WALA WESTERN AL  
 NALA NATIONAL AL  
 45 ANEA AIR NEW ENGLAND  
 WTAA WESTAIR COMMUTER A  
 ABXA ABX A  
 MALA MESABA AV  
 50 PCAA PENNSYLVANIA COMMUTE  
 RMXA OMNIFLIGHT HELICOPTERS  
 SIMA SIMMONS AL  
 BRIA BRITT AW  
 55 ZIAA ZANTOP INT  
 RAIA TRANS STATES AL  
 AWAA AIR WISCONSIN AL  
 RAAA REEVE ALEUTIAN AW  
 EISA EXPRESS ONE INT  
 60 P5CA POLAR AC  
 MIDA MIDWAY AL  
 PLGA BUSINESS EXPRESS  
 CKSA AMERICAN INT  
 65 PAYA TRANS WORLD EXPRESS  
 VTZA ATLANTIC COAST



NVEA AMERICAN EAGLE  
 ARWA ARROW A  
 SCNA SUN COUNTRY AL  
 MGMA MGM GRAND A  
 ASPA ASPEN AW  
 RYNA RYAN INT  
 EMEA EMERALD A  
 REXA EXPRESS AL  
 RIAA RICH INT  
 NACA NORTHERN AC  
 RAXA ROSENBALM AV  
 KTIA KEY AL  
 TCAA TRANS CONTINENTAL AL  
 PREA PRECISION VALLEY AVI  
 SPAA SIERRA PACIFIC AL  
 ERAA ERA AV  
 FWTA FLORIDA WEST AL  
 A6WA AIR WISCONSIN AL  
 IXXA AIR TRANSPORT INT  
 BUFA BUFFALO AW  
 S2YA ASTRAL  
 GRAA GREAT AMERICAN AW  
 GAIA KITTY HAWK AC  
 MASA MESA AL  
 COEA EMPIRE AL  
 TALA TRANS AIR LINK  
 RAYA OKLAHOMA  
 PDLA PRESIDENTIAL AW  
 GATA GULF AIR TRANSPORT  
 MVAA MISSISSIPPI VALLEY AL  
 HERA HERMENS A  
 IMPA IMPERIAL AL  
 CAPS OKLAHOMA  
 AFLA MIDWAY AL  
 FLTA FLIGHT TRAILES  
 GWAT OKLAHOMA  
 AORA OKLAHOMA  
 ALTT OKLAHOMA  
 ALGA OFFSHORE LOGISTICS  
 AIAA ATORIE A  
 PATX OKLAHOMA  
 CCDA CASCADE AW  
 HPJA APOLLO AW  
 ONEA AIR ONE  
 EIAS OKLAHOMA  
 REPA REPUBLIC AL  
 AMWA AIR MIDWEST  
 NAXA OKLAHOMA  
 HNAA HENSON AV  
 SWIA SKYWEST AL  
 PCTA PORTS OF CALL  
 FTLA FLYING TIGER LINE  
 MTRA METROFLIGHT  
 PSAA PACIFIC SOUTHWEST  
 C2XA CONTINENTAL EXPRESS  
 BHAA BAR HARBOR AW

ACLA AIRCAL  
 TIAA TRANSAMERICA AL  
 SALA SUBURBAN AL  
 ASOA ATLANTIC SOUTHEAST AL  
 5 PSAX OKLAHOMA  
 PEXA PEOPLE EXPRESS  
 PEXA PEOPLE EXPRESS  
 VNAA JETSTREAM INT  
 10 FAVA AVAIR  
 EMXA METRO EXPRESS  
 TAGA ORION AIR  
 CHQA CHAUTAUQUA AL  
 15 TIAS TRANSAMERICA  
 CAIA COMMAND AW  
 FTLS FLYING TIGER  
 CPLA CHAPARRAL AL  
 20 WWMA WINGS WEST AL  
 PBAA PROVINCETOWN BOSTON AL  
 GLBA GREAT LAKES AV  
 NYAA NEW YORK AL  
 25 CROA CROWN AW  
 SAAS OKLAHOMA  
 WRNA TRADEWINDS  
 SUNA SUN AIRE LINES  
 ACAX OKLAHOMA  
 30 MEJA MERLIN EXPRESS  
 ISAA INTERSTATE AL  
 ZIAX OKLAHOMA  
 RMAA ROCKY MOUNTAIN AW  
 35 RIOA RIO AW  
 IASA INTERNATIONAL AIR SERV  
 FLEA FLORIDA EXPRESS  
 AIAA OKLAHOMA  
 40 BRTA BRITT AL  
 FECT OKLAHOMA  
 R7MA ROCKY MOUNTAIN HOLIDAYS  
 UF6A UFS I  
 45 FLAA CAMAIR INT  
 PQAA PUERTO RICO INT AL  
 SMBA SEDALIA MARSHALL BOONVIL  
 ONAS OKLAHOMA  
 50 JJBA CHAMPLAIN ENTERPRISE  
 WRTA WRIGHT AL  
 RANA RANSOME A  
 TRBA EXECUTIVE  
 55 MAAA MIDSTATE AL  
 SWAX OKLAHOMA  
 RDLS OKLAHOMA  
 ANAA ANA  
 60 GPPA OKLAHOMA  
 RAIX OKLAHOMA  
 RAHT OKLAHOMA  
 FECZ OKLAHOMA  
 65 SCIA SCENIC AL  
 PCTX PORTS OF CALL  
 SMMA SUMMIT AL

## 33

A4JA OKLAHOMA MAY 99  
 ACA OKLAHOMA MAY 99  
 ACZA OKLAHOMA MAY 99  
 AETA OKLAHOMA MAY 99  
 ARWR OKLAHOMA MAY 99  
 ASRA OKLAHOMA MAY 99  
 B4MR OKLAHOMA MAY 99  
 CAPA OKLAHOMA MAY 99  
 CICA PARADISE ISLAND  
 EF2R OKLAHOMA MAY 99  
 GEMA OKLAHOMA MAY 99  
 HCMA HELICOPTER CONSULTANT  
 IU6R OKLAHOMA MAY 99  
 JAMA OKLAHOMA MAY 99  
 MACA OKLAHOMA MAY 99  
 MIAS OKLAHOMA MAY 99  
 PCSA OKLAHOMA MAY 99  
 PIOA OKLAHOMA MAY 99  
 PSA OKLAHOMA MAY 99  
 RDLA OKLAHOMA MAY 99  
 RJEF OKLAHOMA MAY 99  
 SBWS OKLAHOMA MAY 99  
 SWJA OKLAHOMA MAY 99  
 SWXA OKLAHOMA MAY 99  
 TWUA OKLAHOMA MAY 99  
 VG5R OKLAHOMA MAY 99  
 VSTA OKLAHOMA MAY 99  
 Y2PA USA JET  
 ZYWA WEST MICHIGAN AIR CARE  
 DFLT DEFAULT  
 ATA 2 CHARACTER CODES (50 values)  
 SERV PLACARD MARKING  
 SERV FUEL OIL COOLANT  
 HELICOPTER VIBRATE  
 AIR CONDITIONING  
 JAUTO PILOT  
 COMMUNICATIONS SYSTEM  
 ELECTRICAL POWER SYSTEM  
 INTERIOR EQUIPMENT  
 FIRE PROTECTION  
 FLIGHT CONTROL SYSTEM  
 FUEL SYSTEM  
 HYDRAULIC SYSTEM  
 ANTI-ICE SYSTEM  
 INSTRUMENTS  
 LANDING GEAR  
 LIGHTING SYSTEM  
 NAVIGATION SYSTEM  
 OXYGEN SYSTEM  
 PNEUMATIC SYSTEM  
 VACUUM SYSTEM  
 WATER/WASTE SYSTEM  
 CENTRAL MAINT COMPUTER  
 AIRBORNE APU SYSTEM  
 PRACTICE/STRUC/BALLOON  
 DOORS  
 FUSELAGE

## 34

NACELLE/PYLON STRUCTURE  
 EMPENNAGE STRUCTURE  
 WINDOW/WINDSHIELD SYSTEM  
 WING STRUCTURE  
 5 PROPELLER SYSTEM  
 MAIN ROTOR SYSTEM  
 MAIN ROTOR DRIVE  
 TAIL ROTOR  
 10 TAIL ROTOR DRIVE SYSTEM  
 ROTORCRAFT FLIGHT CONTROL  
 POWER PLANT  
 ENG TURBINE/TURBOPROP  
 15 ENG FUEL & CONTROL  
 IGNITION SYS  
 ENG BLEED AIR SYSTEM  
 ENG CONTROLS  
 20 ENG INDICATING SYSTEM  
 ENG EXHAUST  
 ENG OIL SYSTEM  
 ENG START  
 25 TURBINE SYSTEM RECIP ONLY  
 WATER INJECTION  
 ACCESSORY GEAR BOXES  
 ENGINE RECIPROCATING  
 30 ATA 4 CHARACTER CODES (448 values)  
 PLACARDS AND MARKINGS  
 FUEL SERVICING  
 OIL SERVICING  
 35 HYDRAULIC FLUID SERVICING  
 COOLANT SERVICING  
 HELICOPTER VIB NOISE ANALYSIS  
 HELICOPTER VIBRATION ANALYSIS  
 HELICOPTER NOISE ANALYSIS  
 40 AIR CONDITIONING SYSTEM  
 COMPRESSOR SYSTEM  
 AIR DISTRIBUTION SYSTEM  
 AIR DISTRIBUTION FAN  
 45 PRESSURIZATION CONTROL SYSTEM  
 PRESSURE CONTROLLER  
 PRESSURE INDICATOR  
 REGULATOR-OUTFLOW VALVE  
 50 PRESSURE SENSOR  
 HEATING SYSTEM  
 COOLING SYSTEM (AIR VAPOR CYCLE)  
 TEMPERATURE CONTROL SYSTEM  
 TEMPERATURE CONTROLLER  
 55 CABIN TEMPERATURE INDICATOR  
 CABIN TEMPERATURE SENSOR  
 HUMIDITY CON OL SYSTEM  
 AUTO FLIGHT SYSTEM  
 60 AUTOPILOT SYSTEM  
 AUTOPILOT COMPUTER  
 ALTITUDE CONTROLLER  
 FLIGHT CONTROLLER  
 65 AUTOPILOT TRIM INDICATOR  
 AUTOPILOT MAIN SERVO  
 AUTOPILOT TRIM SERVO

## 35

SPEED-ATTITUDE CORRECTION SYSTEM  
 AUTO THROTTLE SYSTEM  
 AERODYNAMIC LOAD ALLEVIATING  
 COMMUNICATIONS SYSTEM  
 HF COMMUNICATION SYSTEM  
 UHF COMMUNICATION SYSTEM  
 VHF COMMUNICATION SYSTEM  
 DATA TRANSMISSION AUTO CALL  
 PA & ENTERTAINMENT SYSTEM  
 INTERPHONE  
 AUDIO INTEGRATING  
 STATIC DISCHARGE SYSTEM  
 AUDIO & VIDEO MONITORING  
 ELECTRICAL POWER SYSTEM  
 ALTERNATOR-GENERATOR DRIVE SYSTEM  
 AC GENERATION SYSTEM  
 AC GENERATOR-ALTERNATOR  
 AC INVERTER  
 PHASE ADAPTER  
 AC REGULATOR  
 AC INDICATING SYSTEM  
 DC GENERATION SYSTEM  
 BATTERY OVERHEAT WARNING SYSTEM  
 BATTERY CHARGER  
 DC RECTIFIER-CONVERTER  
 DC GENERATOR-ALTERNATOR  
 STARTER-GENERATOR  
 DC REGULATOR  
 DC INDICATING SYSTEM  
 EXTERNAL POWER SYSTEM  
 AC POWER DISTRIBUTION SYSTEM  
 DC POWER DISTRIBUTION SYSTEM  
 EQUIPMENT FURNISHINGS  
 FLIGHT COMPARTMENT EQUIPMENT  
 PASSENGER COMPARTMENT EQUIP  
 BUFFET GALLEYS  
 LAVATORIES  
 CARGO COMPARTMENTS  
 AGRICULTURAL EXTERNAL LOAD SYSTEM  
 EMERGENCY EQUIPMENT  
 LIFE JACKET  
 EMERGENCY LOCATOR BEACON  
 PARACHUTE  
 LIFE RAFT  
 ESCAPE SLIDE  
 ACCESSORY COMPARTMENTS  
 BATTERY BOX STRUCTURE  
 ELECTRONIC SHELF SECTION  
 FIRE PROTECTION SYSTEM  
 DETECTION SYSTEM  
 SMOKE,DETECTION  
 FIRE,DETECTION  
 OVERHEAT,DETECTION  
 EXTINGUISHING SYSTEM  
 FIRE BOTTLE,FIXED  
 FIRE BOTTLE,PORTABLE

## 36

FLIGHT CONTROL SYSTEM  
 CONTROL COLUMN SECTION  
 AILERON CONTROL SYSTEM  
 AILERON TAB CONTROL SYSTEM  
 RUDDER CONTROL SYSTEM  
 RUDDER TAB CONTROL SYSTEM  
 RUDDER ACTUATOR  
 ELEVATOR CONTROL SYSTEM  
 ELEVATOR TAB CONTROL SYSTEM  
 STABILIZER CONTROL SYSTEM  
 STABILIZER POSITION IND SYSTEM  
 STABILIZER ACTUATOR  
 TE FLAP CONTROL SYSTEM  
 TE FLAP POSITION IND SYSTEM  
 TE FLAP ACTUATOR  
 DRAG CONTROL SYSTEM  
 DRAG CONTROL ACTUATOR  
 GUST LOCK-DAMPER SYSTEM  
 LE FLAP CONTROL SYSTEM  
 LE FLAP POSITION IND SYSTEM  
 LE FLAPACTUATOR  
 FUEL SYSTEM  
 FUEL STORAGE  
 FUEL DISTRIBUTION  
 FUEL FILTER-STRAINER  
 FUEL PUMPS  
 FUEL SELECTOR SHUTOFF VALVE  
 FUEL TRANSFER VALVE  
 FUEL DUMP  
 FUEL INDICATION SYSTEM  
 FUEL QUANTITY INDICATOR  
 FUEL QUANTITY SENSOR  
 FUEL TEMPERATURE  
 FUEL PRESSURE  
 HYDRAULIC POWER SYSTEM  
 HYDRAULIC, MAIN SYSTEM  
 ACCUMULATOR, MAIN  
 FILTER, MAIN  
 PUMP, MAIN  
 HANDPUMP, MAIN  
 PRESSURE RELIEF, MAIN  
 RESERVOIR, MAIN  
 PRESSURE REGULATOR,MAIN  
 HYDRAULIC, AUXILIARY SYSTEM  
 ACCUMULATOR, AUXILIARY  
 FILTER, AUXILIARY  
 PUMP, AUXILIARY  
 HANDPUMP, AUXILIARY  
 PRESSURE RELIEF, AUXILIARY  
 RESERVOIR, AUXILIARY  
 PRESSURE REGULATOR, AUXILIARY  
 HYDRAULIC, INDICATING SYSTEM  
 PRESSURE INDICATOR  
 PRESSURE SENSOR  
 QUANTITY INDICATOR  
 QUANTITY SENSOR

## 37

ICE RAIN PROTECTION SYSTEM  
 AIRFOIL ANTI-ICE, DEICE  
 INTAKE ANTI-ICE,DEICE  
 PITOT STATIC ANTI-ICE  
 WINDOWS WINDSHIELDS & DOORS  
 ANTENNA RADOME ANTI-ICE  
 PROP ROTOR ANTI-ICE, DEICE  
 WATER LINE ANTI-ICE  
 ICE DETECTION  
 INDICATING RECORDING SYSTEM  
 INSTRUMENT PANEL  
 INDEP INSTRUMENT (CLOCK,ETC)  
 DATA RECORDERS (FLIGHT MAINT)  
 CENTRAL COMPUTERS (EG EICAS)  
 CENTRAL WARNING  
 CENTRAL DISPLAY  
 AUTOMATIC DATA  
 LANDING GEAR SYS  
 LANDING GEAR WHEEL FAIRING  
 MAIN LANDING GEAR  
 MAIN LANDING GEAR ATTACH SEC  
 EMERGENCY FLOATATION SECTION  
 MAIN GEAR STRUT AXLE TRUCK  
 NOSE TAIL LANDING GEAR  
 NOSE TAIL GEAR ATTACH SECTION  
 NOSE TAIL GEAR STRUT AXLE  
 GEAR EXTENSION AND RETRACT SYSTEM  
 LANDING GEAR DOOR RETRACT SEC  
 LANDING GEAR DOOR ACTUATOR  
 LANDING GEAR ACTUATOR  
 LANDING GEAR SELECTOR  
 LANDING GEAR BRAKES SYSTEM  
 ANTI-SKID SECTION  
 BRAKE  
 MASTER CYLINDER BRAKE VALVE  
 TIRE CASING  
 TUBE  
 WHEEL SKI FLOAT  
 LANDING GEAR STEERING SYSTEM  
 STEERING UNIT  
 SHIMMY DAMPER  
 LG POSITION AND WARNING  
 AUX GEAR (TAIL ROTORCRFT SKID)  
 LIGHTING SYSTEM  
 FLIGHT COMPARTMENT LIGHTING  
 PASSENGER COMPARTMENT LIGHTING  
 CARGO COMPARTMENT LIGHTING  
 EXTERIOR LIGHTING  
 EMERGENCY LIGHTING  
 NAVIGATION SYSTEM  
 FLIGHT ENVIRONMENT DATA  
 PITOT STATIC SYSTEM  
 AIR TEMPERATURE THRUST LIMIT  
 RATE OF CLIMB  
 AIRSPEED MACH INDICATING  
 HIGH SPEED WARNING

## 38

ALTIMETER, BAROMETRIC ENCODER  
 AIR DATA COMPUTER  
 STALL WARNING SYSTEM  
 5 ATTITUDE & DIRECTION  
 ATTITUDE GYRO & INDICATION  
 DIRECTIONAL GYRO & INDICATION  
 MAGNETIC COMPASS  
 10 TURN AND BANK RATE OF TURN  
 INTEGRATED FLIGHT DIRECTOR SYSTEM  
 LANDING AND TAXI AIDS  
 LOCALIZER VOR SYSTEM  
 GLIDE SLOPE SYSTEM  
 15 MICROWAVE LANDING SYSTEM  
 MARKER BEACON SYSTEM  
 HEADS UP DISPLAY SYSTEM  
 WIND SHEAR DETECTION SYSTEM  
 20 INDE POSITION DETERMINING SYSTEM  
 INERTIAL GUIDANCE SYSTEM  
 WEATHER RADAR SYSTEM  
 DOPPLER SYSTEM  
 25 GROUND PROXIMITY SYSTEM  
 AIR COLLISION AVOIDANCE (TCAS)  
 NON RADAR WEATHER SYSTEM  
 DEPENDENT POSITION DETERMINING  
 30 DME/TACAN SYSTEM  
 ATC TRANSPONDER SYSTEM  
 LORAN SYSTEM  
 VOR SYSTEM  
 35 ADF SYSTEM  
 OMEGA NAVIGATION SYSTEM  
 GLOBAL POSITIONING SYSTEM  
 FLT MANAGEMENT COMPUTING SYSTEM  
 OXYGEN SYSTEM  
 40 CREW OXYGEN SYSTEM  
 PASSENGER OXYGEN SYSTEM  
 PORTABLE OXYGEN SYSTEM  
 PNEUMATIC SYSTEM  
 45 PNEUMATIC DISTRIBUTION SYSTEM  
 PNEUMATIC INDICATING SYSTEM  
 VACUUM  
 VACUUM DISTRIBUTION SYSTEM  
 50 VACUUM INDICATING SYSTEM  
 WATER AND WASTE SYSTEM  
 POTABLE WATER SYSTEM  
 WASH WATER SYSTEM  
 55 WASTE DISPOSAL SYSTEM  
 AIR SUPPLY (WATER PRESS SYSTEM)  
 CENTRAL MAINTENANCE COMPUTER  
 AIRBORNE APU SYSTEM  
 60 APU ASSEMBLY AND COWL  
 APU CORE ENGINE  
 APU ENGINE FUEL AND CONTROL  
 APU START IGNITION SYSTEM  
 65 APU BLEED AIR SYSTEM  
 APU CONTROLS  
 APU INDICATING SYSTEM

## 39

APU EXHAUST SYSTEM  
 APU OIL SYSTEM  
 STANDARD PRACTICES STRUCTURES  
 AIRCRAFT STRUCTURES  
 BALLOON/DIRIGIBLE REPORTS  
 DOORS/  
 PASSENGER/CREW DOORS  
 EMERGENCY EXIT  
 CARGO/BAGGAGE DOORS  
 SERVICE DOORS  
 GALLEY DOORS  
 ELECT/ELECTRONIC COM DOORS  
 HYDRAULIC COMPARTMENT DOORS  
 ACCESSORY COMPARTMENT DOORS  
 AIR CONDITIONING COMP DOORS  
 FLUID SERVICE DOORS  
 AUXILIARY POWER UNIT DOOR  
 TAIL CONE DOOR  
 FIXED INNER DOORS  
 ENTRANCE STAIRS  
 DOOR WARNING  
 LANDING GEAR DOORS  
 FUSELAGE  
 AERIAL TOW EQUIPMENT SECTION  
 ROTORCRAFT TAIL BOOM  
 FUSELAGE MAIN STRUCTURE  
 FRAMES (MAIN FUSELAGE)  
 BULK HEADS (MAIN FUSELAGE)  
 LONGERONS STRINGERS (MAIN FUS)  
 KEELS (MAIN FUSELAGE)  
 FLOOR BEAMS (MAIN FUSELAGE)  
 FUSELAGE AUXILIARY STRUCTURE  
 FLOOR PANELS (AUX FUSELAGE)  
 INTERNAL MOUNT STRUC (AUX FUS)  
 INTERNAL STAIRS (AUX FUS)  
 FIXED PARTITIONS (AUX FUS)  
 PLATES SKINS (AUX FUSELAGE)  
 FUSELAGE ATTACH FITTINGS SYS  
 WING ATTACH FITTINGS (ON FUS)  
 STAB ATTACH FITTINGS (ON FUS)  
 GEAR ATTACH FITTINGS (ON FUS)  
 DOOR HINGE (ON FUSELAGE)  
 EQUIP ATTACH FITTINGS (ON FUS)  
 ENGINE ATTACH FITTING (ON FUS)  
 SEAT/CARGO ATTACH FITTING  
 AERODYNAMIC FAIRINGS STRUCTURE  
 NACELLES/PYLONS STRUCTURE  
 MAIN FRAME (ON NACELLES PYLON)  
 FRAMES (ON NACELLES/PYLON)  
 BULKHEAD FIREWALLS (NAC PYLON)  
 LONGERON STRINGERS (NAC PYLON)  
 PLATES/SKINS (NACELLE/PYLON)  
 ATTACH FITTINGS (NAC PYLON)  
 EMPENNAGE STRUCTURE  
 HORIZONTAL STABILIZER  
 SPARS/RIBS (HORIZONTAL STAB)

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PLATES/SKINS (HORIZONTAL STAB)  
 TAB STRUC (HORIZONTAL STAB)  
 ELEVATORS  
 5 SPARS/RIBS (ON ELEVATOR)  
 PLATES/SKINS (ON ELEVATOR)  
 TAB STRUCTURE (ON ELEVATOR)  
 VERTICAL STABILIZER  
 SPARS/RIBS (ON VERT STAB)  
 10 PLATES/SKINS (ON VERT STAB)  
 VENTRAL STRUC (ON VERT STAB)  
 RUDDER  
 SPARS/RIBS (ON RUDDER)  
 15 PLATES/SKINS (ON RUDDER)  
 TAB STRUCTURE (ON RUDDER)  
 ATTACH FITTINGS (FLT CONTROLS)  
 HORIZONTAL STAB ATTACH FITTING  
 20 ELEVATOR/TAB ATTACH FITTING  
 VERTICAL STAB ATTACH FITTING  
 RUDDER/TAB ATTACH FITTING  
 WINDOWS-WINDSHIELD SYSTEM  
 25 FLIGHT COMPARTMENT WINDOWS  
 PASSENGER COMPARTMENT WINDOWS  
 DOOR WINDOWS  
 INSPECTION WINDOWS  
 30 WING STRUCTURE  
 MAIN FRAME (ON WING)  
 SPAR (ON WING)  
 RIBS/BULKHEAD S (ON WING)  
 35 LONGERONS/STRINGERS (ON WING)  
 CENTER WING BOX (ON WING)  
 AUXILIARY STRUCTURE (ON WING)  
 PLATES/SKINS (ON WING)  
 40 ATTACH FITTINGS (ON WING)  
 FUS (ATTACH FITTING ON WING)  
 NAC/PYLON (FITTING ON WING)  
 LANDING GEAR (FITTING ON WING)  
 CONT SURFACE (FITTING ON WING)  
 45 FLIGHT SURFACE S (WING)  
 AILERONS  
 AILERON TABS  
 TRAILING EDGE FLAPS  
 50 LEADING EDGE DEVICES  
 SPOILERS  
 PROPELLER SYSTEM  
 PROPELLER ASSEMBLY  
 55 PROPELLER BLADE SECTION  
 PROP DEICE BOOT SECTION  
 PROP/SPINNER SECTION  
 PROPELLER HUB SECTION  
 60 PROPELLER CONTROLLING SYSTEM  
 PROP SYNCHRONIZER SECTION  
 PROPELLER GOVERNOR  
 PROPELLER FEATHER/REVERSING  
 65 PROPELLER BRAKING  
 PROPELLER INDICATING SYSTEM  
 MAIN ROTOR SYSTEM

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MAIN ROTOR BLADE SYSTEM  
 MAIN ROTOR HEAD SYSTEM  
 MAIN ROTOR MAST/SWASHPLATE  
 MAIN ROTOR INDICATING SYSTEM  
 MAIN ROTOR DRIVE  
 ENGINE/TRANSMISSION COUPLING  
 MAIN ROTOR GEARBOX  
 MAIN ROTOR BRAKE  
 ROTORCRAFT COOLING FAN SYSTEM  
 MAIN ROTOR TRANS MOUNT  
 ROTOR/DRIVE INDICATING SYSTEM  
 TAIL ROTOR  
 TAIL ROTOR BLADE  
 TAIL ROTOR  
 TAIL ROTOR INDICATING SYSTEM  
 TAIL ROTOR DRIVE SYSTEM  
 TAIL ROTOR DRIVE SHAFT  
 TAIL ROTOR GEARBOX  
 TAIL ROTOR DRIVE IND SYSTEM  
 ROTORCRAFT FLIGHT CONTROL  
 MAIN ROTOR CONTROL  
 TILT ROTOR FLIGHT CONTROL  
 TAIL ROTOR CONTROL SYSTEM  
 ROTORCRAFT SERVO SYSTEM  
 POWER PLANT  
 ENGINE COWLING SYSTEM  
 COWL FLAP SYS (RECIP. ONLY)  
 ENG AIR BAFFLE SEC (RECIP.)  
 MOUNTS  
 FIRESEALS  
 AIR INTAKE  
 ENGINE DRAINS  
 ENGINE (TURBINE TURBOPROP)  
 REDUCTION GEAR AND SHAFT  
 AIR INLET SECTION (CORE ENG)  
 COMPRESSOR SECTION  
 COMBUSTION SECTION  
 TURBINE SECTION  
 ACCESSORY DRIVES  
 OIL SYSTEM  
 BYPASS SECTION  
 ENGINE FUEL AND CONTROL  
 FUEL DISTRIBUTION  
 FUEL OIL COOLER  
 FUEL HEATER  
 FUEL INJECTOR NOZZLE  
 FUEL PUMP  
 FUEL CONTROLLING SYSTEM  
 FUEL CONTROL ELECTRONIC  
 FUEL CONTROL CARBURETOR  
 TURBINE GOVERNOR  
 FUEL DIVIDER  
 FUEL INDICATING SYSTEM  
 FUEL FLOW INDICATING  
 FUEL PRESSURE INDICATING  
 FUEL FLOW SENSOR

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FUEL PRESS SENSOR  
 IGNITION SYSTEM  
 IGNITION POWER SUPPLY  
 LOW TENSION COIL  
 5 EXCITER  
 INDUCTION VIBRATOR  
 MAGNETO DISTRIBUTOR  
 DIST (IGNITION HARNESS)  
 10 SPARK PLUGS IGNITERS  
 SWITCHING  
 ENGINE BLEED AIR SYSTEM  
 ENGINE ANTI-ICING SYSTEM  
 15 ENGINE COOLING SYSTEM  
 COMPRESSOR BLEED CONTROL  
 COMPRESSOR BLEED GOVERNOR  
 COMPRESSOR BLEED VALVE  
 20 INDICATING SYSTEM  
 ENGINE CONTROLS  
 ENGINE SYNCHRONIZING  
 MIXTURE CONTROL  
 25 POWER LEVER  
 EMERGENCY SHUTDOWN SYSTEM  
 ENGINE INDICATING SYSTEM  
 POWER INDICATING SYSTEM  
 30 ENGINE PRESSURE RATIO (EPR)  
 BME TORQUE  
 MANIFOLD PRESSURE (MP)  
 RPM  
 35 TEMPERATURE INDICATING SYSTEM  
 CYLINDER TEMP (CHT)  
 EGT TIT  
 ANALYZERS  
 40 IGNITION ANALYZER  
 VIBRATION ANALYZER  
 INTEGRATED ENGINE INST SYSTEM  
 ENGINE EXHAUST  
 45 COLLECTOR NOZZLE  
 NOISE SUPPRESSOR  
 THRUST REVERSER  
 ENG OIL SYSTEM (AIRFRAME FURNISH)  
 OIL STORAGE (AIRFRAME FURNISH)  
 50 ENG OIL DIST (AIRFRAME FURN)  
 COOLER  
 TEMPERATURE REGULATOR  
 OFF VALVE  
 55 ENGINE OIL INDICATING SYSTEM  
 PRESSURE  
 QUANTITY  
 TEMPERATURE  
 60 ENGINE STARTING  
 CRANKING  
 STARTER  
 VALVES CONTROLS  
 65 TURBINE SYSTEM (RECIP. ONLY)  
 POWER RECOVERY TURBINE  
 TURBO SUPERCHARGER

WATER INJECTION  
 ACCESSORY GEAR-BOXES  
 ENGINE (RECIPROCATING)  
 ENGINE FRONT SECTION  
 ENGINE POWER SECTION  
 ENGINE CYLINDER SECTION  
 ENGINE REAR SECTION  
 ENGINE OIL SYSTEM

What is claimed is:

1. An information system for analysing data comprised of events pertaining to an object class wherein the object class is aircraft and an individual object is an individual aircraft having one or more identifiers unique to that individual aircraft, the system comprising:

- (a) a data access component configured for accessing a database comprising multiple, integrated sets of data records derived from different sources whereby each data record pertains to an event for an individual object and comprises data fields, the data fields comprising multiple identifiers identifying said individual object;
- (b) a user interface component for receiving user-selected criteria for field values of the data fields;
- (c) a pre-processor component configured for identifying multiple sub-databases from the data records of the database whereby each sub-database comprises data records identified by a different identifier, or a different set of identifiers, than those of the other sub-databases;
- (d) a selection component configured for selecting from one or more of the sub-databases the data records which correspond to the user-selected criteria; and,
- (e) an analysis component configured for:
  - analysing the selected data records including identifying the selected data records according to a chronological sequence of events for individual objects covered by those selected data records, whereby each individual object covered by the selected data records is associated with a longitudinal set of data records; and
  - deriving output data for the events from the longitudinal sets of data records.

2. An information system according to claim 1 wherein the information provided by one said set of data records is used to supplement other data records of said database.

3. An information system according to claim 2 wherein the information provided by another one of said sets of data records is used to correct erroneous data field values in data records obtained from any said source.

4. An information system according to claim 3 wherein data records are service difficulty reports each said report pertaining to one said individual aircraft.

5. An information system according to claim 4 wherein said analysis component is configured for standardizing said data reports and individual objects as between the different originating sources thereof.

6. An information system according to claim 5 wherein said standardizing is performed on the basis of the traffic

patterns for each aircraft and the types of aircraft models of each said originating source.

7. An information system according to claim 2 and further comprising a graphizer output component configured for graphically displaying said output data by multi-result inter-related graphs.

8. An information system according to claim 2 wherein said analysis component is configured for identifying chronological trends for one or more said individual objects and/or data records.

9. An information system according to claim 1 wherein said analysis component is configured for surveiling said events on a chronological basis for one or more said individual objects.

10. An information system according to claim 1 wherein said analysis component is configured for comparing, on a chronological basis and measured from a user-selected event, the events pertaining to one said individual object and the events pertaining to a user-selected comparison group of said objects.

11. An information system according to claim 1 wherein said analysis component is configured for normalizing the field values for a set of data fields and outputting the resulting normalized data.

12. An information system according to claim 1 wherein said analysis component is configured for identifying related data records of said data records.

13. An information system according to claim 1 wherein said analysis component is configured for identifying a statistically high number of events for an individual object within a designated time period.

14. An information system according to claim 1 wherein said analysis component is configured for rating said originating sources of said data records on the basis of the diligence of said originating sources in reporting events.

15. A method for analyzing data comprised of events pertaining to an object class, said method comprising the steps:

- (a) accessing a database comprising at least one set of data records whereby each data record pertains to an individual said object and comprises a plurality of data fields, at least one of said data fields comprising an identifier identifying one said individual object;
- (b) receiving user-selected criteria for field values of said data fields;
- (c) selecting those of said data records which correspond to said user-selected criteria; and,
- (d) analyzing said data records including identifying said selected data records according to a chronological sequence of events for individual objects covered by said selected data records, whereby each said individual object covered by said selected data records is associated with a longitudinal set of data records, and deriving output data for said events from said longitudinal sets of data records.

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 6,631,384 B1  
APPLICATION NO. : 09/654911  
DATED : October 7, 2003  
INVENTOR(S) : Alex Richman, Elliott M. Richman and Mark Hudak

Page 1 of 3

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE CLAIMS

Claim 2, col. 43, lines 43 and 44, delete “wherein the” and insert -- configured for using --

Claim 2, col. 43, lines 44 and 45, “is used” should be deleted;

Claim 3, col. 43, lines 46 and 47, delete “wherein the” and insert -- configured for using --;

Claim 3, col. 43, line 48, “is used” should be deleted;

Claim 3, col. 43, line 49, -- of -- should be inserted between “any” and “said” and “source” should be replaced with -- sources --;

Claim 4, col. 43 line 50, “3” should be replaced with --1 -- and -- said -- should be inserted between “wherein” and “data”;

Claim 4, col. 43, line 51, delete “are” and insert -- comprise --;

Claim 7, col. 44, line 3, “2” should be replaced with -- 1 --;

Claim 8, col. 44, line 7, “2” should be replaced with --1 --;

Claim 15, col. 44, line 37, -- whereby the object class is aircraft and an individual object is an individual aircraft having one or more identifiers unique to that individual aircraft -- should be inserted between “object class” and “said method”;

Claim 15, col. 44, line 39 and 40, “ at least one set of data records” should be deleted;

Claim 15, col. 44 line 39 -- multiple, integrated sets of data records derived from different sources -- should be inserted between “comprising” and “whereby each”;

Claim 15, col. 44, line 40, -- event for an -- should be inserted between “to an” and “individual”;

Claim 15, col. 44, line 41, “a plurality of” should be deleted;

Claim 15, col. 44, lines 42 and 43 “at least one of said data fields comprising an identifier indentifying one said individual object” should be deleted;

Claim 15, col. 44, line 42 --the data fields comprising multiple identifiers indentifying said individual object -- should be inserted after “data fields”



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Page 2 of 3

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE CLAIMS (cont'd)

Claim 15, col. 44, line 46, -- identifying multiple sub-databases from the data records of the database whereby each sub-database comprises data records identified by a different identifier, or a different set of identifiers, than those of the other sub-databases; -- should replace (c) as issued

Claim 15, col. 44, line 46, replace "(c)" with -- (d) -- ;

Claim 15, col. 44, line 46, delete "those of" ;

Claim 15, col. 44, line 48, replace "(d)" with -- (e) --;

Claim 15, col. 44, line 48, delete the first instance of "said" and replace it with -- the selected -- ;

Claim 15, col. 44, line 48, delete the second instance of "said" and replace it with -- the --;

Claim 15, col. 44, line 51, delete the first instance of "said" and replace it with -- those --

Claim 15, col. 44, line 51, delete the second instance of "said";

Claim 15, col. 44, line 52, delete "said" and replace it with -- the --;

Claim 15, col. 44, lines 53 - 55, delete ", and deriving output data for said events form said longitudinal sets of data records." and insert -- ; and --

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

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Page 3 of 3

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE CLAIMS (cont'd)

Claim 15, col. 44, line 56, insert -- (f) deriving output data for said events from the longitudinal sets of data records. --

Signed and Sealed this

Twenty-second Day of May, 2007

A handwritten signature in black ink on a light gray dotted background. The signature reads "Jon W. Dudas" in a cursive style.

JON W. DUDAS

*Director of the United States Patent and Trademark Office*